Modeling Violent Non-State Actors: A Summary of Concepts and Methods

Captain Jason Bartolomei, USAF
Major William Casebeer, USAF
Major Troy Thomas, USAF

November 2004

Institute for Information Technology Applications
United States Air Force Academy, Colorado

IITA Research Publication 4
Information Series

Report Documentation Page

Form Approved
OMB No. 0704-0188

1. REPORT DATE	2. REPORT TYPE	3. DATES COVERED
NOV 2004		**00-00-2004 to 00-00-2004**

4. TITLE AND SUBTITLE	5a. CONTRACT NUMBER
Modeling Violent Non-State Actors: A Summary of Concepts and Methods	5b. GRANT NUMBER
	5c. PROGRAM ELEMENT NUMBER
6. AUTHOR(S)	5d. PROJECT NUMBER
	5e. TASK NUMBER
	5f. WORK UNIT NUMBER
7. PERFORMING ORGANIZATION NAME(S) AND ADDRESS(ES) **Institute for Information Technology Applications,USAFA/DFEI,2354 Fairchild Drive,USAF Academy,CO,80840-6258**	8. PERFORMING ORGANIZATION REPORT NUMBER
9. SPONSORING/MONITORING AGENCY NAME(S) AND ADDRESS(ES)	10. SPONSOR/MONITOR'S ACRONYM(S)
	11. SPONSOR/MONITOR'S REPORT NUMBER(S)

12. DISTRIBUTION/AVAILABILITY STATEMENT
Approved for public release; distribution unlimited

13. SUPPLEMENTARY NOTES
The original document contains color images.

14. ABSTRACT

15. SUBJECT TERMS

16. SECURITY CLASSIFICATION OF:			17. LIMITATION OF ABSTRACT	18. NUMBER OF PAGES	19a. NAME OF RESPONSIBLE PERSON
a. REPORT **unclassified**	b. ABSTRACT **unclassified**	c. THIS PAGE **unclassified**		**50**	

ABOUTH THE AUTHORS

Jason Bartolomei

Captain Jason Bartolomei is a 1997 graduate of Marquette University, where he majored in Mechanical Engineering. He has an MS in Systems Engineering from the Air Force Institute of Technology. He is an USAF acquisitions officer with experience as a systems engineer and an integrated product team lead at the F/A-22 System Program Office. Most recently he served as an Assistant Professor of Engineering Mechanics and Director of Systems Engineering at the US Air Force Academy. Currently, he is a PhD candidate at the Massachusetts Institute of Technology's Engineering Systems Division where he is developing innovative approaches for complex systems analysis and design.

William D. Casebeer

Major Bill Casebeer is a 1991 graduate of the US Air Force Academy, where he majored in political science. He has an MA in Philosophy from the University of Arizona, and a PhD in Cognitive Science and Philosophy from the University of California at San Diego. He is an intelligence analyst with experience in the Southwest Asian arena. He was formerly an Associate Professor of Philosophy at the US Air Force Academy, and is currently attending the Naval Postgraduate School Middle East Area Studies program. His research interests include the neural mechanisms of moral judgment, military ethics, computer modeling, and the intersections of cognitive science and national security issues such as the psychology of terrorism. A term member with the Council on Foreign Relations, Bill's book "Natural Ethical Facts: Evolution, Connectionism, and Moral Cognition" is available from MIT Press, and his co-authored book "Warlords Rising: Countering Violent Non-State Actors" is forthcoming with Lexington Press.

Troy S. Thomas

Major Troy S. Thomas is an Air Force officer with experience leading airmen in homeland defense (Noble Eagle) and expeditionary operations in the Middle East (Iraqi Freedom, Enduring Freedom, Southern Watch, and Vigilant Warrior). Troy served as the Intelligence Flight Commander of the 1st Fighter Wing, an operational planner with 7th Air Force in South Korea, intelligence analyst with 9th Air Force, chief of intelligence for the 55th Fighter Squadron, staff officer in the Pentagon, Fellow with the Center for Strategic Intelligence Research, and an Assistant Professor of Political Science at the US Air Force Academy. A distinguished graduate from the Air Force Academy, he holds a MA in Government from the University of Texas, Austin, and a MA in Organizational Management from George Washington University. Troy is a term member with the Council on Foreign Relations and a member of the Council for Emerging National Security Affairs. Travel to over 35 countries informs his publications on leadership, conflict, intelligence, and Islam. Troy is currently attending the USMC School of Advanced Warfighting at Quantico.

The views expressed in this publication are those of the authors and do not necessarily reflect the official policy or position of the Institute for Information Technology Applications, the Department of the Air Force, the Department of Defense of the U.S. Government.

Comments pertaining to this report are invited and should be directed to:

Sharon Richardson
Director of Conferences and Publications
Institute for Information Technology Applications
HQ USAFA/DFEI
2354Fairchild Drive, Suite 4L35F
USAF Academy CO 80840-6258
Tel. (719) 333-2746; Fax (719) 333-2946
Email: mailto:sharon.richardson@usafa.af.mil

TABLE OF CONTENTS

TABLES

FIGURES

Modeling Violent Non-State Actors:
A Summary of Concepts and Methods

INTRODUCTION AND SUMMARY

Violent non-state actors (VNSA), such as terrorist organizations, play an increasingly important role in the international security environment. Effectively deterring, coercing, disrupting or destroying terrorist organizations requires a subtle understanding of the factors that influence their growth and formation. Here, we discuss the importance of formulating systems-level computer models that may enable us to forecast VNSA growth, and that also give us leverage for effects-based operations and planning. We apply tools from systems engineering to turn our *qualitative* systems-level mental models of VNSA into *quantitative* computer models. By using a systems engineering approach, policy-makers will be able to expand the number and quality of their mental models surrounding reasoning about how VNSA develop in order to gain deeper insights. The methodologies used in this project will be useful for analyzing *any* complex system, not just terrorist organizations.

SETTING THE STAGE: VNSA, THEIR RISE, AND THEIR NATURE

Donkey carts laden with rocket-propelled grenades, teenage girls wrapped in nails and explosives, and civilian airliners filled with fuel and travelers--these are the weapons found in the arsenal of today's most ubiquitous adversary—the violent non-state actor (VNSA). With few exceptions, VNSA play a prominent, often destabilizing role in nearly every humanitarian and political crisis faced by the international community. A sample from across today's geo-political landscape reveals a Hamas suicide bomber haunting the streets of Jerusalem, Nepalese Maoists launching another round of bombings in Katmandu, and a Jemaah Islamiya militant preparing a car bomb to rival the 2002 attack in Bali. As non-state armed groups gain greater access to resources and networks through global interconnectivity, they have also come to dominate the terrain of illegal trade in drugs, guns and humans. The broad spectrum of objectives and asymmetric methods of these contemporary Assassins and Barbary Pirates fractures our traditional conceptions of war and peace. Whether concerned about national security or human security, the warlords of the modern era pose a pressing challenge for which the nation-state is ill-equipped.

Our work aspires in part to equip those charged with confronting this mounting challenge by *delivering an improved understanding of VNSA in order to affect their development and performance*. To achieve the first half of this goal, understanding the VNSA, we introduce and employ an inter-disciplinary methodology, rooted in open systems theory, guided by modern organization theory, and framed using systems engineering tools and processes. Our analytical framework represents an alternative paradigm for diagnosing armed non-state organizations as *open systems* on three inter-related levels. At the environmental level, it provides more powerful insight to the conditions and dynamics that shape VNSA formation and development. At the organizational level, it directs our inquiry toward holistic characteristics and relationships that enable VNSA to prosper, adapt and achieve goals. Conversely, the open systems

methodology exposes weakness—vulnerabilities directly related to developmental phasing, environmental dynamics and internal mechanisms. The internal workings of the VNSA represent the third level of analysis, which focuses our attention on the organization's functions and their contribution to overall performance during periods of uncontested growth and more importantly, in the context of a turbulent environment. The open systems methodology is a universal framework for a global problem set. As a transportable tool, it allows for structured analysis across regions, which is increasingly important given the transnational character of VNSA. Recognizing the uniqueness of groups like Hezbollah, the levels of analysis also provide common scaffolding on which the signatures of specific groups can be built.

Thus equipped, the other half of our goal, affecting VNSA development and performance, can be tackled. Whether the policy maker's goal is preventing, coercing or conquering, we offer an innovative strategy for countering VNSA. We examine the utility of traditional theories of deterrence and warfighting in light of the insight gained through open systems analysis. In so doing, we elevate and sketch out the role of environmental shaping in VNSA development, recast deterrence in ecological terms that incorporates emotional as well as rational factors, and proffer principles for crafting strategy and operations to ultimately defeat the adversary. The result is an integrated approach that marries diagnosis to strategy, and optimistically, enables forecasting future organizational behavior and assessing the effects of a counter-VNSA campaign. At the end of the day, we establish a comprehensive framework that links analysis to action and action to analysis.

VNSA are a distinct form of non-state actor, which distinguishes them from police forces and militaries. It is their use of collective violence that most clearly distinguishes Sendero from Starbucks, but their goals and methods also contribute to their illegitimacy. They are illegitimate vis-à-vis the classical state system in part because the essence of being a state is having a monopoly on the legitimate use of violence. By definition, VNSA resort not only to random or opportunistic aggression, but to collective violence as a tool to achieve goals. Collective violence is really an extension of collective action, which is coordinated action by the members of the group in pursuit of common ends.

Analytical Approach

Open systems theory serves as the diagnostic framework for our inter-disciplinary analysis of VNSA. We have deliberately used the term diagnosis several times already. As applied in modern organization theory, diagnosis is the *process of employing conceptual models and methods to assess* a target organization's condition in order to solve problems and increase performance.[1] We diagnose VNSA for a different, but related purpose: assess the capabilities of threatening organizations in order to decrease and deny their performance. Our diagnosis is framed by open systems theory; meaning it is directed by an open systems-informed theoretical framework, which is less deterministic than a theory, but still allows for analysis of key concepts and the relationships among them.[2]

The open systems framework springs from the general systems theory of Ludwig von Bertalanffy in the 1940s, but it did not catch hold in the social sciences until the 1960s and 1970s. Championed by Daniel Katz and Robert Kahn in their seminal work, *The Social Psychology of Organizations*, and many others that come in to play later in our work, open systems theory emerged as modern organization theory by the 1980s, replacing the more limiting structural approach. Among its many early benefits, the "adoption of a systems frame helped researches in the social sciences to discover commonalities with fields such as biology and engineering, and it provided a basis for an interdisciplinary approach to organizations."[3]

After over sixty years of applied and basic research, open systems theory has emerged as the principal approach to understanding organizations. For the first time here, it is being systematically applied to violent non-state organizations.

At its most basic, open systems theory views all organizations as *systems*, interacting with their environment in a dynamic manner. In the words of its godfather von Bertalanffy, it conceptualizes a system as an "organized cohesive complex of elements standing in interaction."[4] The interaction refers to two generalized patterns of behavior that must keep our attention throughout: (1) the relationship between the VNSA system and its environment, or super-system; and (2) the relationships among the "complex elements," or parts of the organization (known as sub-systems). The latter constitute the transformational processes of the VNSA, while the former draws attention to the reality that organizations are open systems, continually exchanging information and energy with the environment.

Too often organizations are analyzed in isolation from their environment with excess emphasis on internal structures, including organization charts, leadership, rules, formal communications and process efficiency to name a few. While a useful aspect of organizational diagnosis, this *closed system* approach neglects the simple reality that an organization "must interact with the environment to survive; it both consumes resources and exports resources to the environment."[5] As put by Katz and Kahn, "living systems, whether biological organisms or social organizations, are acutely dependent upon their external environment."[6] The VNSA emerges as a response to environmental pressures, and it is in turn affected by contextual constraints and opportunities. Thus, our approach lends itself more to an inter-disciplinary application based on ecology, engineering and social science then it does to the Newtonian physics of closed systems.

It is an understatement to say that open systems are highly complex. As put by noted organizational theorist and practitioner, Richard Daft, "the organization has to find and obtain needed resources, interpret and act on environmental changes, dispose of outputs, and control and coordinate internal activities in the face of environmental disturbances and uncertainty."[7] To simplify, which is essential to ensuring our diagnostic framework is applicable on the street, all organizational systems share the following basic components:

1) importation of energy and resources

2) through-put (transformation of this energy and these resources)

3) export of product to the environment; and

4) dynamic pattern of activities.

Organizational inputs are many, but generally include the raw materials, money, people, equipment and information.[8] Outputs can be objective and subjective, but generally include products, services, ideas and in the case of VNSA, collective violence. The transformations—the ways it converts inputs into outputs—are often the most difficult to diagnose, particularly given the elusive character of VNSA. Finally, all relationships inside and outside the system are dynamic; they involve feedback. As put by Katz and Kahn, "Inputs are also informative in character and furnish signals to the structure about the environment and about its own functioning in relation to the environment."[9]

An initial look inside the organization reveals a dizzying array of activities and behaviors whose overall contribution to system performance seem beyond determination. Systems theory comes to the rescue by structuring these activities for us. Patterns of activity in all organizations are both formal and informal, and they reflect the most basic level of analysis. By examining how people interact with information and tools to accomplish tasks we can discern functions. Functions are *patterns of activity with a purpose that contribute to the whole*. For example, the function of a flashlight is to shine light. Even when the specific patterns of activity remain obscured, we can have confidence that most VNSA will perform functions that fall into one of several general categories known as sub-systems. Sub-systems "perform the specific functions required for organizational survival, such as production, boundary spanning, maintenance, adaptation, and management."[10] Depending upon the level of desired analytic detail, these subsystem functions can be parsed even further. For example, our modeling work thus far has focused on the "attract people" function, which would be associated with the support subsystem (one of four VNSA sub-systems, which include support, maintenance, cognitive and conversion processes).

To summarize, the open systems framework asks us to analyze all organizations, including VNSA, on three levels: environment (super-system), organization (system), and internal elements (sub-systems). Figure 1 depicts these three levels by showing a system, consisting of sub-systems, embedded in an environment with which it exchanges energy and information. In addition to stressing the importance of conducting analysis on relationships within and across levels, we are also left with these key ideas:

> (1) An organization's effectiveness and success depends heavily on its ability to adapt to its environment, shape the environment, or find a favorable environment in which to operate;
>
> (2) Organizations will use their products, services and ideas as inputs to organizational maintenance and growth;
>
> (3) An organization's effectiveness depends substantially on its ability to meet internal system need—including tying people to their roles in the organization, conducting transformative processes and managing operations—as well as on adaptation to the environment; and
>
> (4) Developments in and outside of organization create pressures for change as well as forces for inertia and stability.[11]

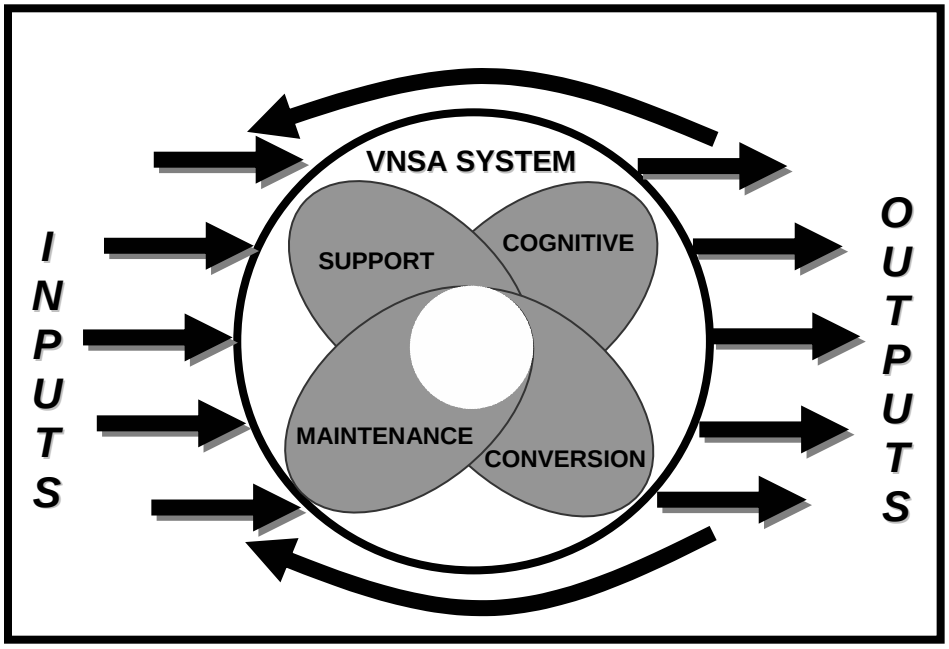


Figure 1 Environment

With these key attributes in mind, we are left with a view of organizations as organic systems. That is, organizations bear more than metaphoric similarity to organisms. They grow, adapt, spawn and in some cases, die. An ecological view of VNSA is consistent with open systems theory and informs our analysis and strategy throughout.

Systems theory is not without its shortcomings, which we are obligated to state upfront and address in the course of our analysis. The first, and probably most important shortcoming is the temptation to rely on system principles that are simply too abstract to be useful to the policy maker and practitioner.[12] Second, an excessive focus on system theory's so-called "laws" can bias the analyst to an artificially narrow view of organizations that ignores other key characteristics. Finally, its value as a framework that provides a common means for analyzing all organizations is undercut by a tendency of researchers "to adopt a superficial approach that overlooks important details of organizational operations and ignores significant differences among organizations and among organizational contexts."[13] We counter these shortcomings with a three-prong strategy. First, we thoroughly develop the key open systems theory concepts throughout our work, providing detailed explanations as necessary. Second, we apply the framework to real VNSA in real settings through the robust use of mini-case studies, empirical data, first-hand accounts, and other forms of evidence. Third, we draw on a variety of disciplines, particularly ecology and the social sciences, to explain and illustrate concepts. It is our hope that this robust analytical approach, backed by rigorous marshalling evidence, makes the case for open systems theory as a lucrative framework for integrating existing methods and developing new, ground-breaking ones.

Overview and Key Concepts

The systems approach also frames our work. We treat the environment as a system; a system-of-systems with its own inputs, transformations and outputs. We look at the

organization as a system, peeling back holistic properties to look inside at functions, strengths and weaknesses. We fix on the organizational output of most concern—collective violence. We set forth a strategy for countering VNSA and broad recommendations for policy respectively. Each piece contributes additional core concepts to our overall goal of diagnosing and achieving effects against VNSA.

Inputs to the environmental super-system are critically important. Environmental conditions, or roots of violence, cultivate communities ripe for mobilization into non-state groups. While every population contains individuals and communities at risk for recruitment (even US citizens joined al Qaida), we focus on those conditions most likely to create the environment in which VNSA emerge and prosper. While there are many dynamic forces impacting the super-system, the roots of violence proffered here have explanatory power regarding the formation of an at-risk population, ripe for mobilization along existing identity lines, known as cleavages. From among the varied sources of human insecurity, our analysis sets forth five conditions for violence: *resource scarcity*, *demographic pressures*, *socio-economic deprivation*, *organized crime and corruption*, and *pre-existing identity cleavages*. Each places significant stress on the individual, civil society and the state. The roots of violence are highly interrelated and a greater stress in each has a synergistic effect on whole. In regions where the synergistic effect is most acute, the environment is more likely to spawn VNSA. Grave stresses across the board are a reasonable indicator of impending group formation.

The roots of violence create optimal conditions for VNSA incubation; however, they are rarely sufficient to convert individual deprivation or communal dissatisfaction into organized violence. Transformations, the engines of change that translate passivity into action, are necessary—failures in governance, identity mobilization and reinforcing behaviors. Current research focuses heavily on state failure as the primary catalyst. We agree that a weakened state is a key intervening variable; however, we amend the traditional view of state failure in terms of weakened capacity to include a broader conception of *failures in governance* to include illegitimacy due to ideological incompatibility, impotence in the ability to provide basic goods and services, and excessive coercion of the population. An often overlooked, but equally importance transformation process is *identity mobilization*, where members of the disaffected community begin to associate with other identity cleavages. The psychological process of identity formation is explored and related to forming or joining a VNSA. A key agent in this conversion is the *identity entrepreneur*, or charismatic leader that leverages the conditions of violence and failures in governance to manipulate identity cleavages. The process is not linear since VNSA will also take *reinforcing actions* to perpetuate the cycle violence. Like organisms, they seek out, adapt to or expand the ecological niche in which they can prosper; it is a type of *niche construction* that deepens the roots of violence. The environmental-level “system of violence” framework shown in Figure 2 captures divergent factors too often examined in isolation; it draws attention to the key relationships that amplify the cycle of violent collective action.

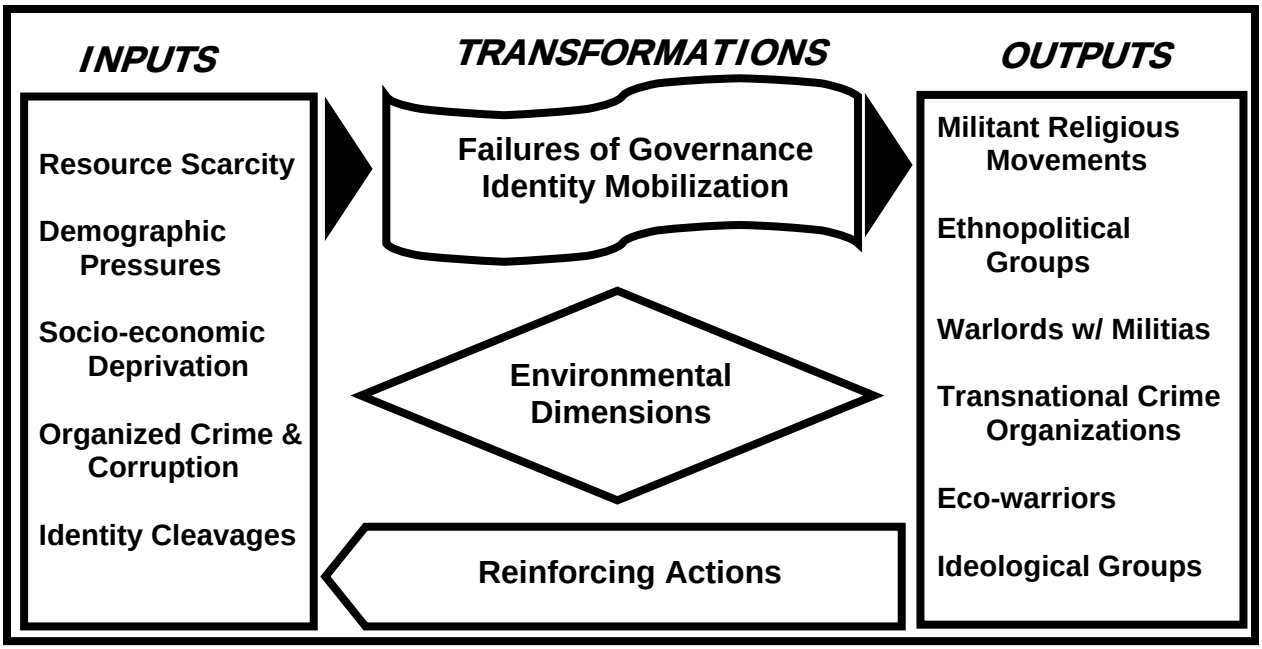


Figure 2 Transformations

We build on this environmental analysis and perform a diagnosis on the organization itself in terms of its system-level properties and sub-system functionality. In doing so, our analysis not only explains how the VNSA works, but it exposes vulnerabilities related to its development. At the system-level, all systems have key characteristics, including inputs, conversions, outputs and feedback. More importantly are the three holistic concepts of life cycle, negative entropy and congruence. First, organizations do not magically appear on the scene. Rather, they pass through a series of *life cycle* phases during which they change in form and function. When the conditions of violence meet a weak state and identity mobilization, incubation occurs and a VNSA enters the gestation phase. As the organization takes initial form, the VNSA will grow, adapting to its environment and becoming increasingly complex and differentiated. If allowed to prosper uncontested, or if highly adaptive even in a turbulent environment, the VNSA may reach maturity in which growth might plateau, but increased efficiencies and the birthing of VNSA progeny may occur. The life cycle is not necessarily liner, since even mature organizations continue to experience growth in some areas, and in the first of two significant divergences from the biological metaphor, organizations can reverse course. Maybe as a result of conscious strategy, but more likely due to environmental constraints, organizations can revert back to a growth phase or even gestation.

The second major divergence from the biological metaphor is the VNSA's ability to flirt with death. Organizations can live forever. Of course, their ability to do is contingent on many factors, not the least of which is its ability to avert the natural entropic process. The tendency toward disorder and decline—information is lost, people fail to uphold role behaviors, conditions worsen—is forestalled by building negative entropy. *Negative entropy* is the "stock of energy," the "store of fuel," and the "winter fat" on which the VNSA draws during periods of crisis. It is common and often appropriate to think of cash reserves, abundant recruits and back-up sanctuaries as the forms of negative entropy relied upon by the VNSA. Through systems analysis, however, other more potent and less appreciated forms emerge, including culture, socialization, social services, intelligence gathering and command and control structures.

Whatever it is, a counter-VNSA strategy must deplete the stores of negative entropy in order to keep the VNSA from reemerging down the road.

The third key system property, *congruence*, deals with the "fit" or "alignment" among sub-systems. A VNSA is most likely to prosper when it achieves reinforcing working relationships among its parts, and importantly, between the organization and its environment. Good fit works against entropy, optimizes performance, and propels the VNSA along its life cycle path. Congruence analysis requires us to determine the factors that contribute most to harmonizing the eleven functions of the four primary sub-systems of all VNSA—support, maintenance, cognitive and conversion. The *support* sub-system manages boundary relations, acquiring resources, recruiting members and attending to stakeholder associations. The *maintenance* sub-system works on the people in the organization by socializing them to a set of values (culture) and enforcing role behaviors through a schedule of rewards and sanctions. The *cognitive* sub-system is responsible for decision-making through learning, strategy development and exercising control over the organization. The *conversion* sub-system works on the energy brought into the organization, training recruits, producing goods and services and conducting operations, which do not always involve collective violence. Each sub-system and associated functions contribute to the VNSA as a whole and take leading roles during different phases in its life cycle.

Depending on the policy maker's requirements, open systems theory allows for deconstructing VNSA along multiple lines based on functions, cognitive style, culture and several other categories. Two inter-related typologies serve as a useful starting point for comparative analysis. The first typology is based on an organization's value system. It contrasts VNSA that reflect largely pragmatic or *transactional* values, with those that embrace a *transcendental* or supernatural world view. Each has implications for how the VNSA is most likely to build negative entropy, weather super-system storms, and relate to other actors in the international system. It is a critical initial distinction on the path to developing a comprehensive countering strategy. The second typology groups VNSA in terms of generally similar goals and functions, resulting in at least the following VNSA species: *warlords with private armies, transnational criminal organizations, militant religious organizations, ethno-nationalist groups, and an emergent set of eco-warriors, anti-globalizationists and anarchists*. For each category certain environmental conditions are most likely to contribute to their gestation as well as the super-system dynamics that are most relevant to survival. Looking inside each species, there are patterns of activity most common to their functions, revealing key insights regarding organizational performance and life cycle vulnerabilities. By also identifying the primary sources for each group's negative entropy, we set a foundation for a tailored strategy.

Of all the system outputs, *collective violence* garners the spotlight even though it may be less critical to system performance than other sub-system functions. Nonetheless, collective violence is one of the two key definitional elements that distinguishes VNSA from other organizations and it's "in your face" impact on security earns our full attention. Collective violence bears relation to organizational development and the role violence plays in achieving VNSA objectives. At some point, VNSA violence verges on the threshold of war, and when it crosses over into this most dynamic of all environmental settings, it changes the face of battle.[14] Drawing on Carl von Clausewitz, a Prussian veteran of the Napoleonic wars and author of the influential book, *On War*, and other military theorists, conflicts involving VNSA involve three decisive tests: *political purpose, engagement, and lethal force*.

The systems-driven evaluation has implications for how we should coerce and ultimately destroy VNSA. Here, we introduce four critical concepts. First is the idea of *ecological*

deterrence. If we accept expanded notions of both what deterrence consists, and what aspects of human psychology are pertinent to it, then we discover it is possible (contrary to the contentions of some theorists) to deter VNSA throughout their life cycles. Second, we return to the overarching counter-VNSA concepts of congruence and negative entropy—by focusing on disrupting the "fit" between all the parts of the system that constitute VNSA, we can cause organizational breakdown; in addition, attacking the "stores of fat" that VNSA accumulate will allow the knock-out blows dealt to VNSA to have immediate organizational impact. Third is the notion of revised *principles of war* for combating open systems; while we should not abandon ideas such as "surprise" and "economy of force," there are other general principles that will aid us in our efforts to war-fight with VNSA, including attacking well-connected nodes and seeking "synergy minus one" interventions. Finally, for assessing the results of our counter-VNSA efforts, we offer the idea of *measures of performance* for attacking systems: we can measure how our efforts are affecting input-related issues (resource utilization), conversion-related issues (process efficiency) and-output related issues (goal attainment). This is a synoptic articulation of how we effectively confront VNSA and assess the effects of our confrontation.

As we confront VNSA, we should keep in mind that: force-on-force confrontations are only a small part of dealing with such organizations; VNSA are neither hermetically nor "hermeneutically" sealed; thinking like ecologists is critically important; effective confrontation takes many forms; and non-traditional intelligence is critical for the entire effort. While our systems scaffolding adds value to any comprehensive security framework, we realize it is nascent and falls short in several respects; so, we also offer an agenda to guide future research on VNSA in the systems vein. Our approach can resolve anomalies and problems afflicting what sometimes appears to be a piece-meal approach to dealing with VNSA, including what are commonly called terrorist groups. In that sense, it is a paradigm shift we must take if we are to confront the grand security challenge of warlords rising.

We will now discuss the modeling portion of our project, where we examine in more detail how we might move from a qualitative understanding of VNSA to a quantitative understanding of their nature via the use of computer models. We offer a repeatable methodology for initially modeling VNSA that leverages systems engineering tools in order to provide structure to how we begin thinking about VNSA. The tools we offer easily facilitate translating thoughts about the structure of organizations such as the Sendero Luminoso into workable computer models that enable us to gain insight into new policy options for dealing with them. They may even provide useful decision-aids for policy makers and an efficient forecasting tool for VNSA growth and recruitment. The model we have constructed of the factors influencing Sendero growth and recruitment rates matches empirical data from the mid-1970s to the early 1990s; while our validation efforts are only preliminary, the model nonetheless provides "proof of concept" that the process we outline is workable. Ultimately, these systems-level computer models add computational bite to some of our qualitative theories, giving policy makers and analysts the ability to easily make revisions to and test foundational assumptions about how VNSA operate. While not a panacea, the process is relatively efficient and inexpensive, and can provide guidance for more expensive higher-fidelity modeling and decision-aid methods. The systems engineering tools and processes we discuss will be a useful part of our counter-VNSA toolkit.

At the end of the day, we seek to understand an enemy that fights with donkey carts and airplanes in order to prevent others from emerging and defeating those that do. We turn now to a discussion of our modeling methodology and results.

VNSA SYSTEM-LEVEL MODEL

Now that we have presented a qualitative understanding of VNSA, we turn to the tools and processes offered by systems engineering to order this understanding into a framework conducive for quantitative analysis.

Developing the Structure of a VNSA Architecture

Systems engineering consists of an array of tools that are used within an iterative process to solve a defined problem; for example, to understand how the parts of plumbing system interact, we would repeatedly apply a version of the steps we recommend below until reaching sufficient understanding of the system for our purposes (this may be a very complex and deep understanding if we are redesigning a bathroom from the ground up, or a relatively shallow understanding if we are merely fixing a leaky faucet). To better understand VNSA structure and processes, we implemented the following steps:

Step 1: Identify VNSA Stakeholders

Step 2: Define Stakeholder Objectives

Step 3: Identify Activities to Achieve Objectives

Step 4: Identify Agents Responsible for Activities

Step 5: Define Measures of Performance for Activities

Step6: Identify System Drivers

Step 7: Highlight the Causality within the System

This process provides a rigorous methodology for efficiently identifying the system boundary (where do we start?) and the critical system variables (what are the important things?). Once the system variables are defined, they can be organized into a system causal matrix structure, which highlights the causal nature between variables, and which is then relatively easy to transform into a systems level computer model. We'll discuss each of these steps in slightly more detail.

VNSA Stakeholders

The process for moving from a qualitative understanding to a quantitative model began by identifying the stakeholder associations, which are a function of the support sub-system. The stakeholders are defined as the individuals and organizations that drive the requirements of the system. Performing a stakeholder analysis is similar to the customer/market analysis required in traditional systems engineering and product development. For typical VNSA, these stakeholders might include sympathetic state leaders, religious leaders, VNSA leaders and identity entrepreneurs, and a vulnerable population which the VNSA is trying to influence. The success of the VNSA hinges on the VNSA's ability to meet the stakeholder requirements; if VNSA can't gather the appropriate human inputs, for example, then in the absence of "negative entropy" (those "stores of fat" that allow organizations to weather hard times, such as stores of recruits waiting in the wings) the organization will eventually collapse.

Defining the Stakeholder Objectives through Functional Analysis

The behavior of any system is based on the structure of the system and the casual relationships between the variables within the system. For VNSA, the stakeholders drive the causal relationships between many of the system variables (for example, if a sympathetic state leader demands that a VNSA commit terrorist acts in Israel if it is to receive continued funding and support, this will spur the development of certain relationships and processes). Therefore, an understanding of the stakeholder's objectives (their vital interests) is necessary to gain insight into the causal structure driving the system behaviors.

In many cases, the stakeholder objectives are easily determined. For instance, Sendero Luminoso leaders are quite vocal about their desires to overthrow the government.[15] Other times, stakeholder interests are less obvious—the Sandenistas were less vocal concerning their desire for wealth and their desires to strengthen their stake in the drug trade. Despite these difficulties, we can work backwards from the actions of the stakeholder to reasonably infer what objectives they are pursuing so as to maximize our chances of correctly identifying vital interests. Engineers often struggle with similar issues when reengineering products designed by other companies ("What were they thinking when they put the power switch on the computer here rather than there? What did they hope to achieve?").

A common methodology employed by engineers to tackle this problem is to perform a functional analysis of existing products. The goal of the functional analysis is to clearly identify the functions of the parts of a physical system. Once the functions for each part are identified, the engineer can reengineer the system so as to (hopefully) improve it. Generally, the functions can be arranged hierarchically. Based on the hierarchy, the objectives of the system can be inferred even in the absence of specific knowledge about the intention of the designers.

VNSA Activities Defined and Classified

In the largest sense, VNSA have as their goal the imposition of their will on others; based on the overall objective of IMPOSING WILL, a mature VNSA will develop multiple subfunctions, with many layers of systems and sub-systems that are performing multitudes of activities. Although the methodology enables us to fully decompose the entire system, here we will only develop the attract people function—a VNSA must be able to recruit if it is to sustain itself. There are many other functions a full-blown VNSA must implement; a comprehensive model would include sketches of those functions also.

Identify VNSA Agents

For each of the activities identified, an agent or multiple agents of the organization must be responsible for the execution of the activities. Paul Davis and Brian Jenkins present the different types of agents found within a VNSA in their excellent book Deterrence and Influence in Counterterrorism: A Component in the War on al Qaeda.[16] These include the following: top leaders, lieutenants, foot soldiers, and recruiters, among others.

Sendero Luminoso (SL hereafter) had multiple agents responsible for recruitment activities to include all of these forms of actors. For example, Abimael Guzman, the founder of the Sendero and himself a university philosophy professor, recruited heavily at San Marcos University in Lima and at his home institution of the University of San Cristobal de Huamanga

(in Ayacucho) during the early stages of SL's development. As the organization grew, SL foot soldiers comprised of Peruvian peasants were able to attract people by leveraging peasant dissatisfaction with the state of their environment and the Peruvian government's responses to it.

VNSA Activity Measures of Performance

Once the activities and the agents are identified, the next questions include: how do we measure whether the agents are successfully achieving their objectives? What are the most important external indicators of the VNSA's organization health and effectiveness? How might the VNSA know when they are meeting their goals?

For the attract people function and supporting activities, we determined that two indicators seemed most logical: total number of VNSA members and total number of VNSA sympathizers. In most cases, the general population of a country does not fill out registration cards for their local VNSA, nor do they volunteer information about their level of sympathy for the VNSA. In the real world, this would require significant human intelligence to determine these measures. For the SL, we looked to historical data presented by David Scott Palmer from 1970-1992.[17]

In addition, other measures of performance for other critical functions and supporting actions might include: VNSA Cash Reserves and Arms Supplies as an-acquire-material function (part of the support sub-system) and number of acts of terror for the commit terror functions (part of the conversion sub-system). For SL, the identification of these variables is important when modeling recruitment since these variables likely directly affect the identity entrepreneur's ability to influence the population (the identity entrepreneur is the person or persons, like Guzman, who exploits existing identity cleavages in order to mobilize a disaffected population).

Identifying the VNSA's measures of performance serves two major functions. First, clearly articulating the measures of performance can be helpful in driving the intelligence requirements in the surveillance of a particular VNSA. In addition, it is important to understand the effectiveness of the VNSA in the execution of activities not only for intelligence and policy effectiveness assessments but also because these activities directly affect other variables of the system that influence VNSA ability to recruit. For example, the larger the VNSA membership, the greater the identity entrepreneur's indirect influence on the population, and also the greater the VNSA's ability to collect intelligence (in support of the authority sub-system). The measure of the identity entrepreneur's influence on the population is a good example of an endogenous variable that is affected and affects other variables within the system. The next step of the process requires a through analysis of the system to identify both the endogenous and exogenous variables with the system.

VNSA System Drivers

We call these internal ("endogenous") and external ("exogenous") variables the VNSA system drivers. These are the variables that directly affect the VNSA's ability to execute activities and conversely can be affected by VNSA's (or state) reinforcing actions. For example, population disaffection is a critical system driver that positively influences the VNSA's ability to attract people. We believe VNSA grow and develop at the intersection of environmental conditions and group psychology; certain environmental variables contribute to the conditions that make VNSA genesis possible. For a VNSA, the system drivers will be the environmental and psychological variables that are influencing the system's key states.

For recruitment, many important environmental variables influence the disaffection of the VNSA's target population. To fully decompose the variables that contribute to population disaffection, we reviewed the literature and relied on expert opinion. We classified the variables into four distinct categories as follows: Maslow variables, Camus variables, Smith variables, and Dewey variables. The Maslow classification represents variables that relate to a population's fundamental needs being met. Maslow variables, named after the developmental psychologist Abraham Maslow, include food and water availability, infant mortality rate, level of medical care, and so on. Camus variables, named after the existential philosopher Albert Camus, include variables that deal with the spiritual and moral fabric of a population (for example, is the population identity such that people are likely to resort to violence to resolve disputes?). Dewey variables, after the philosopher of pragmatism and democracy John Dewey, consist of social factors like freedom of movement, freedom of speech, and the like. Smith variables, named after the economist Adam Smith, represent the system economic variables (such as amount of trade). All of the variables listed above are external to the VNSA and are considered inputs into the system. Exogenous factors are sometimes independent of the VNSA activities; in some cases, it is difficult for the VNSA to influence these variables with reinforcing actions. In other cases, VNSA will expend efforts in "niche construction," which will earn it some influence in otherwise external variables (niche construction occurs when a VNSA actively changes its environment in order to make it more conducive to growth and flourishing); in other words, the VNSA will attempt to turn exogenous variables into endogenous ones.

Examples of endogenous system drivers for the recruitment activities of the VNSA are the variables associated with the role of the identity entrepreneur. For example, in order for the identity entrepreneur to exercise his ability to convert a VNSA sympathizer into a full-fledged member of the VNSA, he must be able to influence society—that ability to influence is a function of the developing authority sub-system in the VNSA. The measure of this ability is hence an endogenous variable that lies within the VNSA and positively affects the VNSA's ability to accomplish its functions. In addition, endogenous variables are factors that the VNSA can more easily affect as they are oft-times directly within the organization's control.

Highlight the Causality within the System

The next step of the process is to highlight the causal relations that exist between variables. A common systems thinking methodology for capturing these casual relations is through the use of causal-loop diagrams. Systems engineers and the product development community when developing complex engineering systems have used an alternative method of capturing these relationships through the use of matrices. Matrices have many advantages; first, they are generally very orderly and efficiently determined, they organize the variables in a structured format, and they enable analysts to quickly determine the boundaries of the system (this can be a taxing effort otherwise).

To determine the causal relations for VNSA, we employed a tailored version of common systems engineering/design matrices designed explicitly for tackling a non-engineering system. We call this tool a System Causal Matrix.

VNSA System Causal Matrix

A System Causal Matrix is a matrix that captures the entirety of variables uncovered through the analysis of steps 1-6 of the process presented above. These variables are organized into the format listed in Figure 3. The matrix in the top left-hand corner captures the Stakeholders and the Stakeholder Objectives into an inter-relational matrix. This is an important matrix

because each stakeholder has objectives supported by the VNSA, and all activities performed by the VNSA flow from these objectives.

The next matrix organizes the hierarchal relationships between the objectives of the system. The highest order objectives and the supporting objectives from the functional analysis described above are placed into the intra-relational matrix. The next matrix is the matrix that correlates the activities and the objectives which those activities support. Moving to the right in Figure 3, the next matrix highlights agent/activity relationship by showing which agents are responsible for the VNSA activities. Next, the VNSA activities and the system drivers are captured in the inter-relational matrix. This is the first causal matrix, where causal relationships between variables are defined. For example, Level of Disaffected Population is a system driver which positively influences the VNSA's ability to cultivate sympathizers. The next matrix connects the VNSA activities with the Measures of Performance for each activity. Each activity should have at least one Measure of Performance.

As we move clockwise around the right-hand side of the diagram, the lower-right hand matrix highlights the causal relationship between Measures of Performance and the System Drivers. This matrix captures the reinforcing or compensating actions the VNSA has on the system drivers. The intrarelational matrix on the left represents the causal relationships between the systems drivers.

The unique arrangement of the system causal matrix not only organizes the variables, but also captures the feedback relationships within the system. Figure 4 is a (merely illustrative) diagram of the VNSA System Causal Matrix which captures the attract people functional activities for the SL. You will notice that although there are many variables within the system, only a few variables are interdependently related, thus only a few of the matrix cells are highlighted with a positive "+" or a negative "-" designator (indicating positive or negative feedback relationships between the two variables).

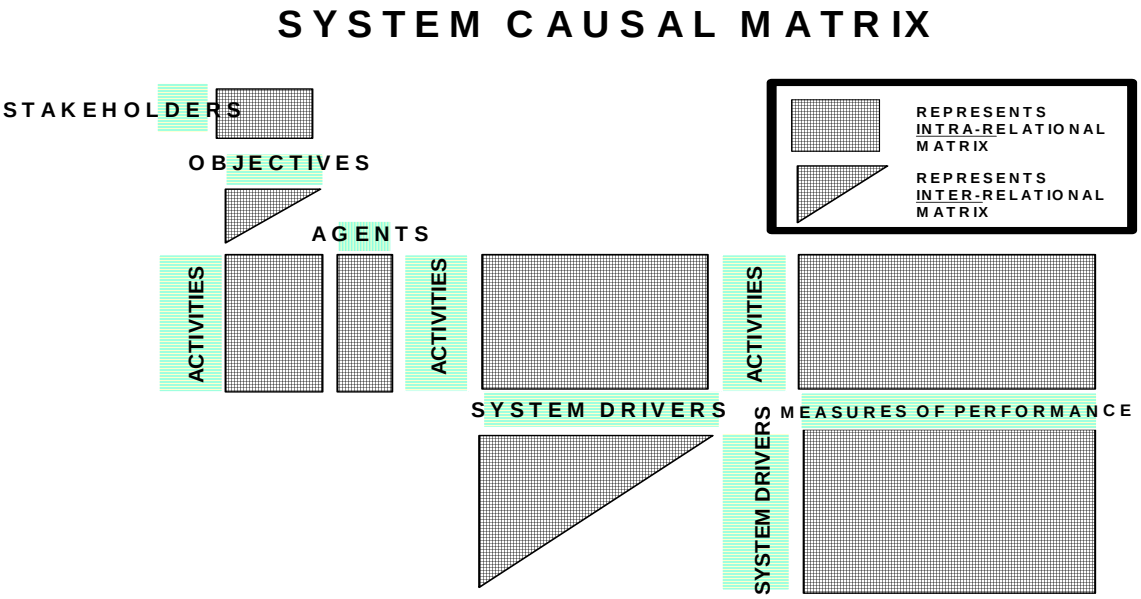

SYSTEM CAUSAL MATRIX
STAKEHOLDERS
OBJECTIVES
AGENTS
ACTIVITIES
ACTIVITIES
ACTIVITIES
SYSTEM DRIVERS
SYSTEM DRIVERS
MEASURES OF PERFORMANCE
REPRESENTS INTRA-RELATIONAL MATRIX
REPRESENTS INTER-RELATIONAL MATRIX

Figure 3

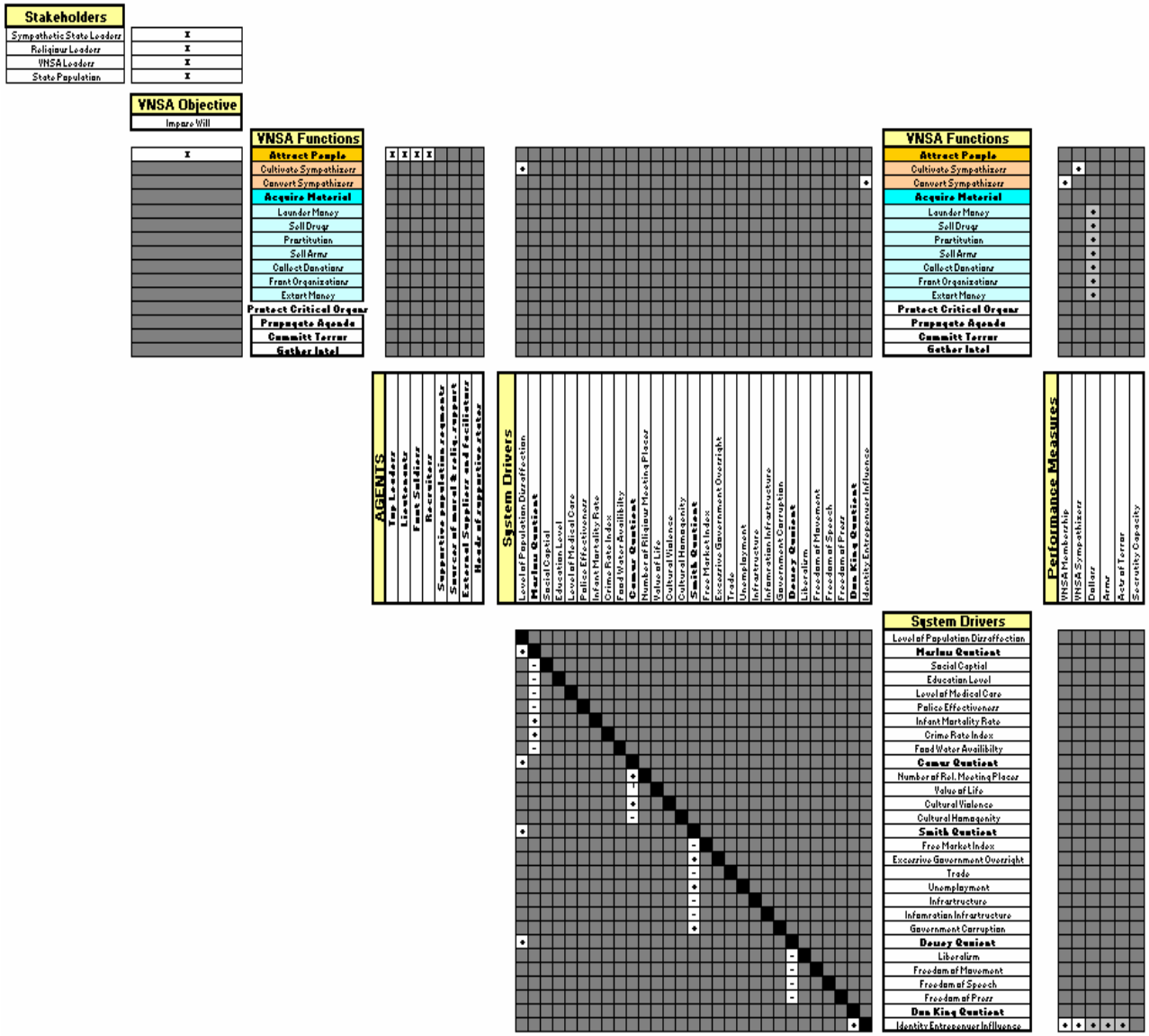


Figure 4 Notional System Causal Matrix for VNSA Recruitment

VNSA Policy Architecture Analysis: Moving from the Matrix to a Systems Level Model

After accomplishing these steps, the policy analyst has a choice that can be satisfied with the insight gained into the system merely by asking and possibly answering these questions. The qualitative insights gained by framing policy problems in this way can be very helpful. Or, the analyst could decide to move from the answers to these questions to a high-level systems dynamics model of the system; in other words, our technique can be used to translate qualitative theories about the nature of the system into quantitative theories and then to models. These models can be quickly built using inexpensive commercially available software such as Stella VIII.

If the analyst decides to model the system mathematically and develop a systems-level simulation of the system she must perform the following steps, which we will discuss only briefly:

Step 8: Determine the Nature of the Causal Relations Mathematically

Step 9: Develop Systems-level Model for the System

Step 10: Perform Validation/Verification of the Model

Systems Level Model Using Stella VIII

Because VNSA development occurs over time, we decided to use a system dynamics approach to create a systems-level model. The first step in this process is to translate the variables defined in the matrix into a "stock and flow" structure based on the causal relationships highlighted in the matrix and the nature of the variables (for example, we may have a stock of $1000 that flows out at the rate of $20 an hour as we buy ammunition for weapons, while money flows in at a rate of $22 an hour from payments from drug lords for protecting their coca crops). Owing to our specific focus on the growth of VNSA and related recruitment activities, we first started by trying to understand the conversion of the general population into sympathizers, and the ability of the VNSA to convert sympathizers into full-blown VNSA members.

Based on our qualitative understanding, population disaffection is a major factor affecting growth and recruitment rates. So we first determined the mathematical nature of these relationships so they can be captured in the model. Figure 5 presents the model interface for these variables—this is where the user can input time series data for the variables in question. Because very little data sometimes exists for these variables, we have to rely on expert opinion when capturing them. Therefore, in the knowledge/data elicitation phase of the project we presented our expert interviewees[18] with x-y axes and ask them to plot the relationship between two variables over time.

One advantage of using a system dynamics approach is the flexibility (inherent in the software and the process) to easily change assumptions and relationships between variables. In many cases, we had dissenting opinions about certain relationships between variables. It was effortless to change the assumptions and test the hypotheses quickly with the systems-level model.

After determining how the general population is converted into sympathizers because of the level of disaffection, the next portion of the model to be tackled was the ability of the VNSA to convert the sympathizer into an actual VNSA member. Based on the relationships uncovered by the matrix, we knew that this was a function of the identity entrepreneur's effectiveness. His effectiveness results from (among other things) his inherent charisma, his finances, and his ability to commit terror, which directly impacts his ability to recruit. Figure 5 illustrates the stock and flow structure of the system by graphically highlighting the variables which contribute to the causal chain. The modeling package used in our exercise allows you to construct these systems of stocks and flows relatively quickly and easily. Once the critical variable relationships are defined with data and/or expert opinion it is time to run the model to test its ability to recreate history.

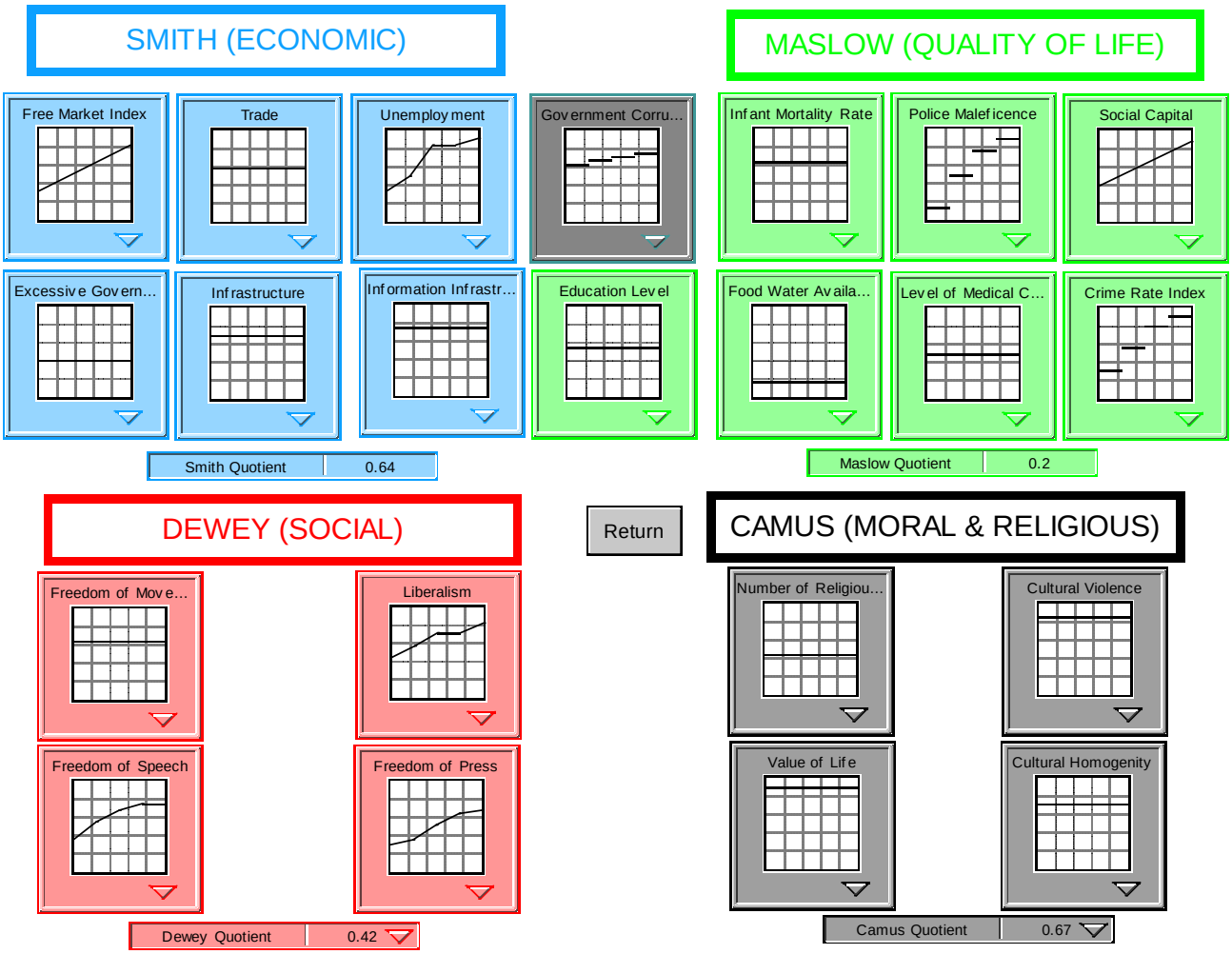


Figure 5 Economic, Social, Quality of Life and Moral Models

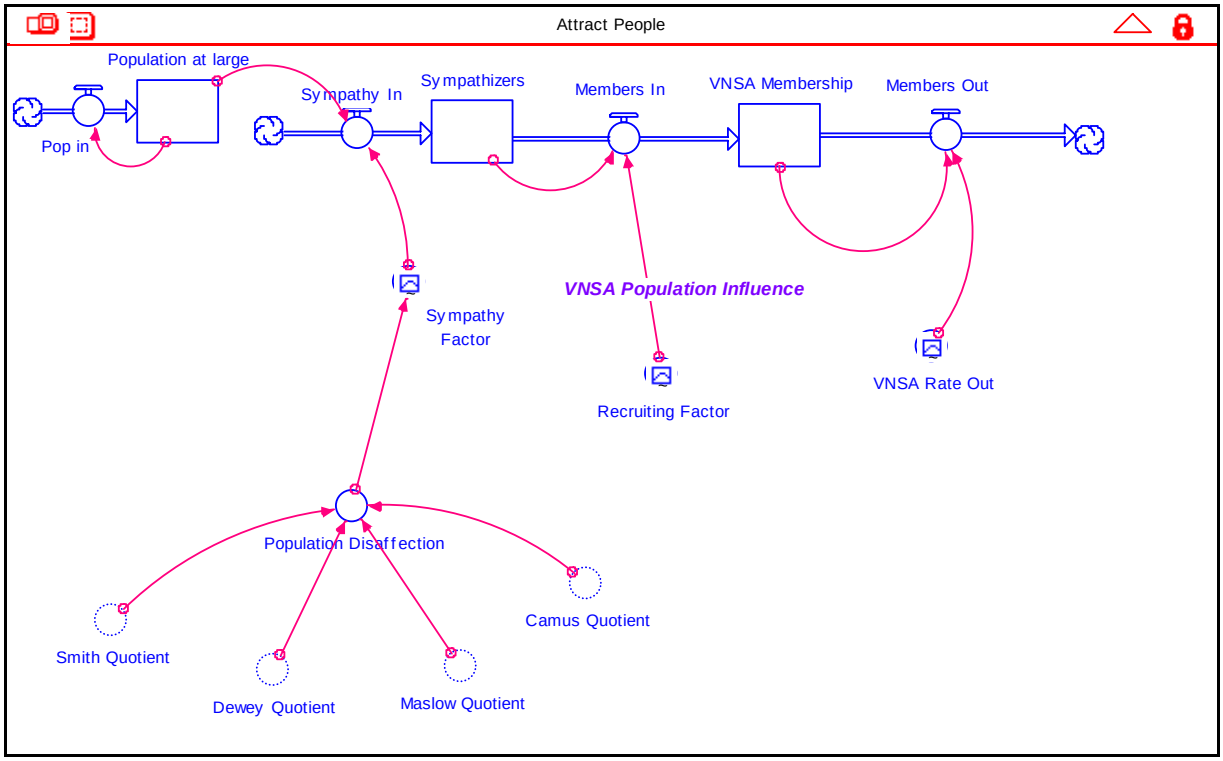


Figure 6 Moded to Attract People

Validation/Verification of SIM Sendero Luminoso

Despite the multiple studies performed on SL, the data available for the important variables uncovered through employing the methodology was quite anemic. In fact, only a few of the variables affecting population disaffection were available in comprehensive and reliable time series (such as infant mortality rates). Thus, we were forced to rely on the opinion of experts for many of the inputs. In addition, David Scott Palmer's historical report on SL cited earlier had valuable information including multiple data points on SL membership, acts of terror, and number of deaths. He had only one data point for SL sympathizers and very rough estimates of SL finances, however. Our goal was to make the best assumptions possible and try to recreate the growth of SL membership from 1970-1992 both in terms of actual cadre members and sympathizers.

Using the best assumptions available, we were able to recreate the curves for VNSA membership growth as shown in Tables 1 and 2 and hit the number of SL sympathizers in 1992 very closely. Despite our success in matching the shape and value of the growth curve, it is far more accurate to describe this model as a rough forecasting tool rather than as having strict predictive value. Overfitting is a constant concern (solved in this case by jackknifing the data),[19] and while it may be possible to develop good forecasts in some tightly constrained circumstances, we are more comfortable describing the process as an insight generating tool and hip-pocket decision aid than as a process for producing predictive models.

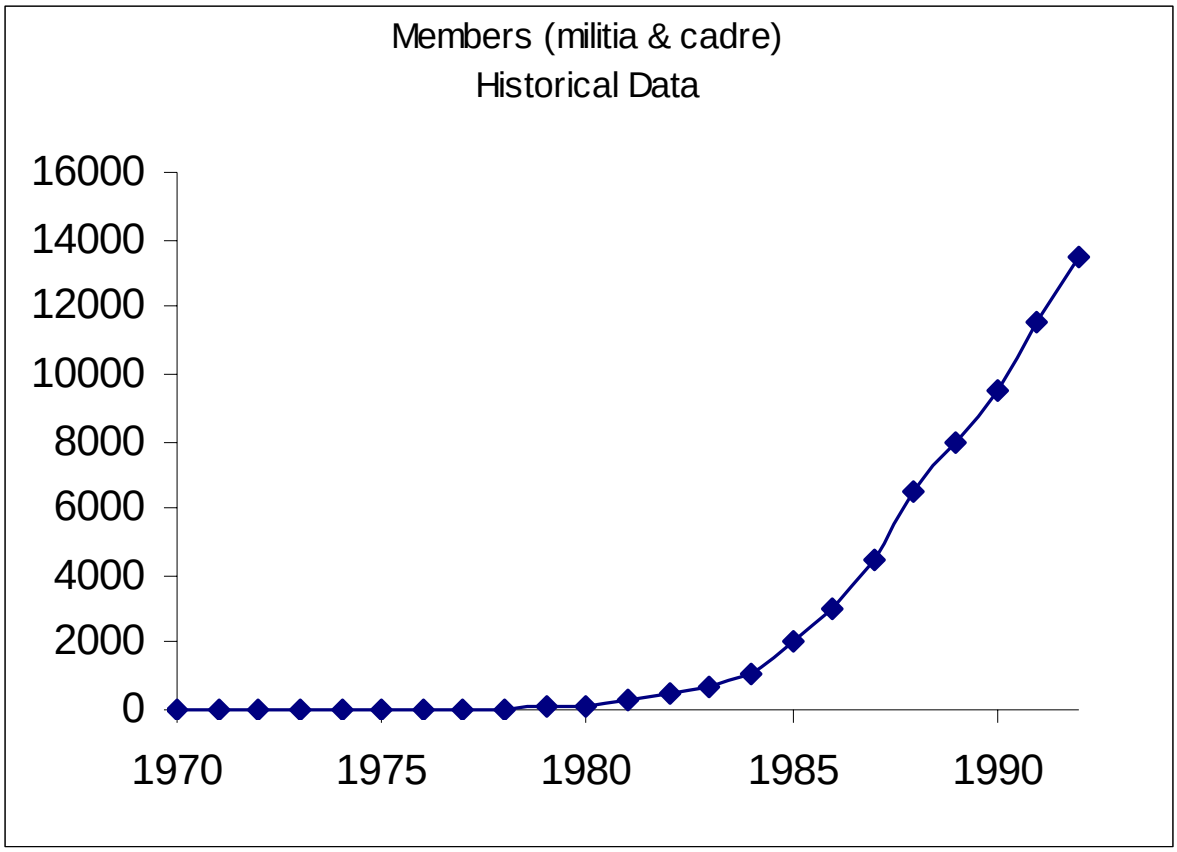


Table 1 Historical Data: Sendero Membership vs. Time

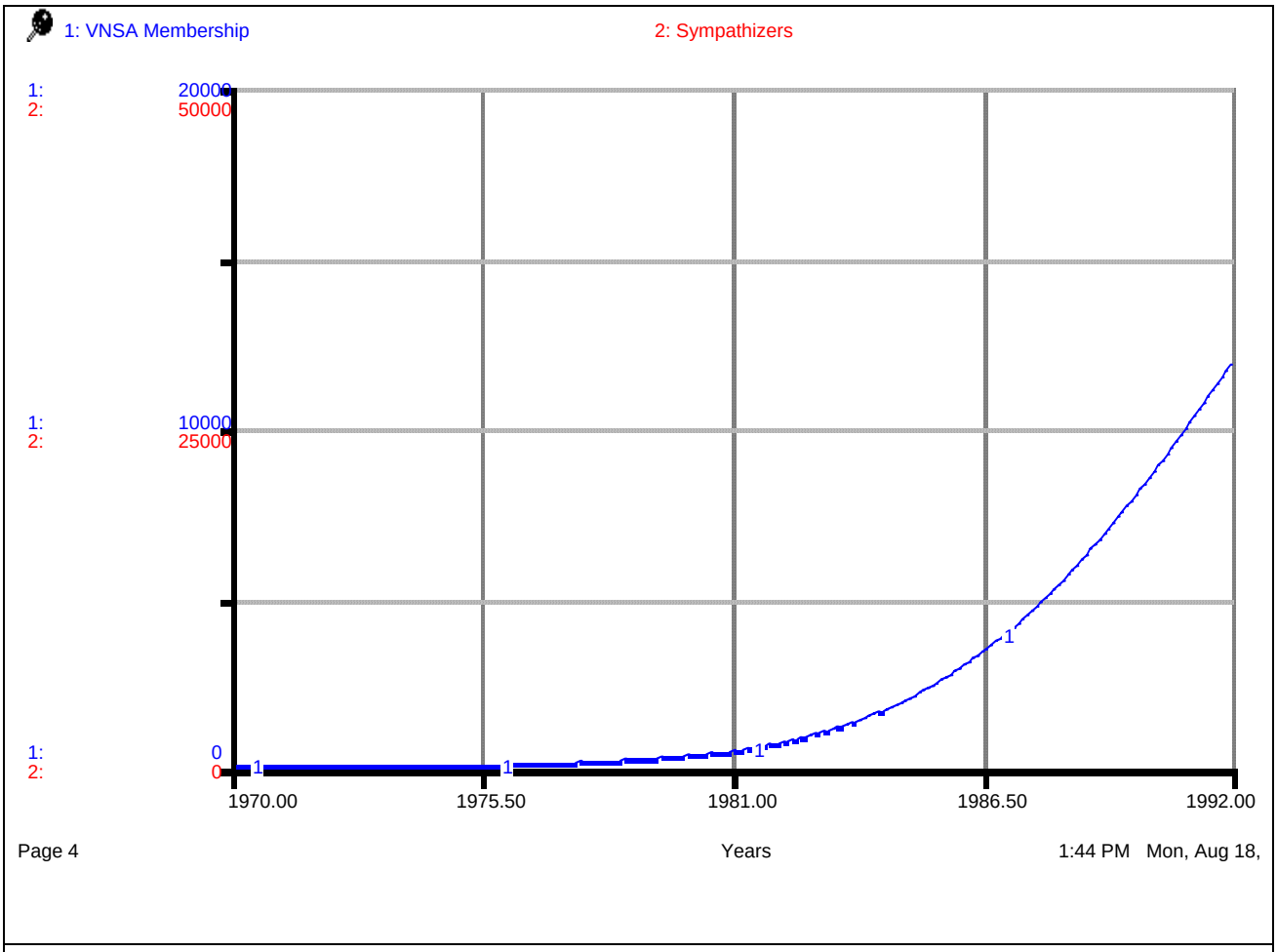


Table 2 Output of the Model: Sendero Membership vs. Time

Use Model to Glean New Insights into the System

We can use our model to brainstorm policy options. For instance, the model forecasts that if we had been able to neutralize the influence Guzman had on the population, recruitment rates would have dropped to near zero (even though disaffection rates stay very high). On the other hand, if we had addressed environmental variables significantly (such as infant mortality rate or amount of trade), we may have nearly halved the size of SL over the course of its ontogeny. These forecasts are problematic, of course, given the nature of the modeling process (they are highly contingent on the quality of the time series data and on expert opinion); but they are very useful, nonetheless, for helping us brainstorm about alternate policy options and for making rough forecasts regarding possible futures. This modeling process can be used to derive computer simulations that can support stem and branch policy analysis (if I did this at this time, what might have happened?); they can also be used to ascertain regret curves (if I got this variable relationship wrong, how much would I regret that?), and that may be useful for helping us sort out intelligence and policy priorities.

Employ Other Analytical Tools to Gain Deeper Insights as Needed

Once high-level systems modeling has been accomplished, a policy maker can use more traditional analytical tools, such as agent-based models, to gain a higher fidelity insight into the system. Our tool complements the other tools available to the modeler. This process is relatively cheap, easy, and low-fidelity. Higher confidence models can be gained by drilling down deeply using more traditional (and usually slower and more expensive) modeling methods.

Benefits of a Systems Level Model

The easy to use graphic interface on these programs makes it unproblematic for analysts and policymakers to use the quantitative system model to gain insight into the system, and possibly even to forecast the consequences of interventions into the system. At the very least, these models can be used for alternate futures analysis, or to drive a stems-and-branches style brainstorming session. They can also help policymakers decide where more time, effort, and other resources should be dedicated (e.g., “we need to conduct a discrete event analysis of the effect that population size and food availability has on regime desperateness…”).

The procedures we’ve argued for in this article are designed to make such high level systems level exploratory modeling quick and easy for the analyst or policymaker. This can be a very valuable process as it may highlight additional policy options available, and is a necessary part of any good effects-based operation. They are a natural fit with the open-systems framework which, we’ve argued in other places, is necessary for a comprehensive examination of terrorist organizations.[20] Our systems-level models could be a crucial tool in helping us effectively confront violent non-state actors.

FUTURE MODELING RESEARCH

Basic and applied research is ongoing. The project team is currently using the methodology to develop and test a set of modules for other VNSA functions (including the critical “commit terror” function). To this end, interviews and ground research were conducted in Central Asia in the summer of 2004, and a “safety-valve” hypothesis regarding rates of terrorism is being

developed and tested (worsening economic conditions combined with a lax immigration policy mean that terrorist groups in Uzbekistan, for example, are not growing at nearly the rate they could if disaffected youth were not allowed to seek employment abroad). In addition, the portability of the methodology to other problem sets is under study (work here has included modeling cadet time use at the Air Force Academy, brain-storming alternate policy options for the North Korean nuclear proliferation issue, and modeling innovation curves in organizational dynamics). In the FY 05-06 timeframe, we expect to finalize the recruitment module, develop at least two other functional modules, operationalize and test the safety-valve hypothesis for Central Asia (the Naval Postgraduate School and the Kazakh government have expressed special interest in this aspect of the project), and continue to educate the community on the methodology via workshops and conference presentations. Current beneficiaries of our products and methodologies include graduate students at several universities; the Joint Warfare Analysis Center; Northern Command; and the Multi-National Forces in Iraq's Strategy, Policy and Assessment directorate.

The systems-level model provides a framework for contingency planning and testing the multiple methods for confronting VNSA. The next section provides a several strategies that might be employed to counter the VNSA threats. As our modeling improves, we might be able to test these strategies and gain insight for which strategy might work well for a given VNSA.

APPLICATIONS TO COUNTER-VNSA/COUNTER-TERRORISM STRATEGY

Confronting violent non-state actors is no easy task, but is instead a challenge that must be undertaken with the appropriate combination of intellectual determination and cognitive humility. Learning to tackle the challenge posed by resurgent VNSA is not optional. Globalization and the concomitant erosion of the Westphalian status quo has changed (and is changing) the international security environment irrevocably, and the growing prevalence of VNSA in transnational conflict ensures they will remain a fixture in the world's political ecology for some time to come.

In our work, we have offered a framework for thinking about violent non-state actors systematically. This framework implies, in turn, a set of strategies for preventing VNSA development, deterring VNSA when they do gestate, and finally for disrupting VNSA integrity across all phases of their life-cycles. A brief review of the territory we have surveyed sets the stage here for a summary of C-VNSA strategy; this will inform a "White Paper for Blue Strategists," where we urge a re-thinking of the war on terror. Finally, we conclude by briefly discussing an agenda for future inquiry driven by our open systems world-view, noting how our research program has the ability to resolve some troublesome anomalies plaguing our current confrontational paradigm.

Core Concepts

The initial territory we explored was that of the *super-system*: the International environment that gives rise to VNSA. Some of the *inputs* into this super-system include such things as resource scarcity, demographic pressures, socio-economic deprivation, organized crime and corruption, and multiple identity cleavages. Against a *background* of globalization, failures of governance on the part of the state (and activity by industrious identity entrepreneurs and myth mongers) can serve as *conversions*, transforming these inputs into the *outputs* of nascent violent non-state actors. Actions (or failures to act) on the part of the state, combined with niche

construction activities on the fledgling VNSA's part, can encourage the growth of the young organization, enhancing the inputs that move it through its ontogeny, effectively foregrounding the background conditions that favored VNSA genesis to begin with.

At the level of the *system*, we were most concerned with the organizational structure exhibited by VNSA: once a VNSA has appeared, what inputs, processes, and outputs enable it to engage in the activities needed to sustain its life and progress through its development? Ultimately, VNSA organizations can take the form of religious movements, ethno-political groups, warlords with militias, transnational criminal organizations, eco-warriors, tribes and clans, city-states, ideological and interest-driven groups, and private security organizations. Despite some differences between these super-system outputs, there are multiple system and sub-system-level commonalities. All these groups follow life cycles, moving from genesis through growth to maturity and, ultimately, transformation. Asking the question "what are the inputs, conversions, and outputs at the *system* level?" necessarily forces us next into a *sub-systems* analysis.

At various parts of the life-cycle, different sub-systems are brought on line so as to engender organizational growth and to allow the organization to develop goals and take steps to achieve them. *Support*, *maintenance*, *cognitive* and *conversion* sub-systems, all active at maturity, ensure ongoing organizational survival and mission accomplishment. Hovering at the nexus of all these sub-systems is organizational *culture*.

The support sub-system procures VNSA inputs and disposes of outputs; VNSA support sub-system activities thus include such things as recruitment, resource acquisition, and stakeholder associations. The maintenance sub-system serves as a kind of clutch between task demands and human needs so as to keep the organization functional; its functions include activities such as socialization and role-related rewards and sanctions. The cognitive sub-system serves the managerial and adaptive role for the organization. Authority related activities thus include things such as learning, strategy development, and organizational control, which includes traditional structural considerations as well as communication means. Finally, the conversion sub-system transforms energy and material in the system into outputs; conversion activities therefore include VNSA operations, training and production. The relative importance of each sub-system varies across the life cycle of the organization.

After discussing some of the legal and ethical issues related to VNSA decisions to engage in terrorist activity, our discussion led naturally to considerations of *coercion* and ultimately *the conquering* of undesirable violent non-state actors. We argued that VNSA can be deterred, especially if we are willing to broaden our notion of what deterrence (and the human psychology that underpins it) consists in. Early in the VNSA life-cycle, affective considerations are more likely to hold sway, while traditional rational actor considerations can effectively deter later in the life cycle. *Ecological deterrence* thus couples ideas regarding the importance of environmental shaping with affective and rational considerations. A more full understanding of deterrence related psychology allows us to see how we can shape VNSA cognition across its life-span.

Should coercion fail, however, system disruption might become a necessity. Conquering VNSA requires formulation of a comprehensive *Counter-VNSA strategy*. A robust C-VNSA strategy requires consideration of the super-system, system, and sub-system aspects of such organizations, all married to a life cycle account of their development. New *principles of war*: leverage diachronic effects, seek "synergy minus one" interventions, disrupt well-connected nodes, leverage feedback loops, increase entropy, disrupt environment/system interfaces, pay attention to life history analysis, increase uncertainty, implement across the system and disrupt

congruence help guide our thinking across all three levels of analysis. In the broadest terms, open systems theory then encourages us to *assess* the effectiveness of our C-VNSA actions in terms of input metrics (how well is the VSNA using resources?), conversion metrics (how efficient is the conversion process?) and output metrics (are VNSA goals being obtained?).

Consideration of these discussions leads next to questions about strategy synthesis and policy criticism: how are we to bring these considerations together into a unified package, and might this unified package cause us to rethink our war on terrorism?

Synchronization

The VNSA is a dynamic enemy engaging in informal warfare. Hence, our C-VNSA strategy, as the principles of war that guide it should have made obvious will itself need to be dynamic. A mantra we would do well to repeat as we formulate grand C-VNSA strategy is "time, location, application." *When* will the instruments of state power be brought against the VNSA? *Where* in the super-system, system, or sub-system? To what end are they *applied*, and what tool (given the dynamic principles of war) will most efficaciously achieve that end? Essentially, our goal must be to synchronize, or orchestrate in time, space and action, a systems-based diagnosis and strategy for VNSA.

Keeping these three questions in mind will enable us to build something like what the military calls a time-phased force deployment diagram (TPFDD) for C-VNSA strategy. Military strategists use a TPFDD to help guide the elaborate and tremendously complex process of staging military personnel and equipment during the build-up to a confrontation. A TPFDD for all the resources that will be brought to bear across the VNSA life-cycle would be invaluable. Certain instruments of state power will be most efficacious at *preventing* VNSA genesis (by addressing root causes and disrupting the connection between the international ecology and transformative processes). Others will be most effective at *slowing* or *shaping* VNSA growth once genesis has already occurred (by pruning back critical inputs, dampening reinforcing actions, and disabling nascent VNSA sub-systems). Still others will be most effective at *disrupting* mature VNSA, using the principles of war and the strategy and tactics implied by them (perhaps by disrupting congruence while simultaneously increasing organizational entropy). Some instruments of state power will be most effective at encouraging the *transformation* of VNSA into non-violent actors (be that by co-optation, negotiated settlement, or destruction).

Understanding the synergetic interrelationships between actions that intervene upon the system earlier and the effects produced later is admittedly very difficult. Good models of this process are problematic to build, although the task is possible using a structured, systems-based computer modeling approach. In any case, whether it be via qualitative or quantitative methods, we need to plot state inputs into and interventions upon the system against VNSA life cycles, ascertaining our action's effectiveness at helping us achieve our desired end-state be it prevention, deterrence, coercion, or disruption and destruction.

The importance of leveraging multiple instruments of state power, including soft power, should be obvious. A "military only" response to the VNSA problem would hamstring our C-VNSA strategy. Numerous instruments of state power ranging from economic aid to transnational education reform to conflict resolution to alternate identity cultivation to targeted special operations to international police cooperation to more traditional military force-on-force confrontations), applied at the right time at the right level of the system, will have maximal impact. At times, it is easy to get the impression that our current counter-terrorism strategy is

driven primarily—with the possible exception of our anti-money laundering efforts—by output considerations, either force-on-force or security-style confrontations of existing VNSA. To address the system only at the level of output, or by confronting only one aspect of the multiple maintenance sub-system functions, is to unnecessarily limit the full range of options we have for confronting VNSA. For this reason, we offer the following white paper for blue strategists (blue in both senses: blue as in "friendly forces in a military exercise," and blue as in "troubled by the shortcomings of our current approach").

A White Paper for Blue Strategists: Rethinking the War on Terror

To ensure we consider the full range of policy options available for confronting VNSA, we offer the following list of bullets. None are "magic" bullets, but taken together, we think they provide a coherent and workable alternative to a C-VNSA strategy sometimes hobbled by a failure to think *system*atically about the nature of violent non-state organizations.

(1) *Force on force confrontations are only a small part of the "confrontational equation."* VNSA embrace asymmetric warfare: the forces they field are non-traditional, striking in ways that maximize the effect they can produce on far larger forces while using only minimal resources. Confronting a VNSA force with yet another force (e.g., using soldiers to stop suicide bombers) can work, in the short term; but to have this as the primary or only aspect of your C-VNSA strategy is to play directly to the strengths of asymmetric confrontations (this is why VNSA chose this tactic to begin with). We must be more asymmetric than our VNSA adversaries, and that involves coalition members striking in ways that maximize the effect *they* can produce using only minimal resources.

Secretary of Defense Donald Rumsfeld expressed much this sentiment in a portion of the infamous two-page memo to his staff (including the chairman of the Joint Chiefs of Staff, General Richard Myers, and Deputy Secretary of Defense Paul Wolfowitz) that was leaked to USA Today on October 22, 2002:

> Does the US need to fashion a broad, integrated plan to stop the next generation of terrorists? The US is putting relatively little effort into a long-range plan, but we are putting a great deal of effort into trying to stop terrorists. The cost-benefit ratio is against us! Our cost is billions against the terrorists' costs of millions.[21]

(2) *VNSA can be deterred.* VNSA are often thought to be irrational. For that reason, critics contend, it's impossible to deter VNSA…they can only be destroyed. However, an open systems perspective on VNSA development reveals multiple opportunities we have to influence VNSA ontogeny in a way that uses proximate psychological mechanisms to preclude action contrary to our interests. Broaden our notion of deterrence and of psychology, and use those expanded notions to deter VNSA when they can be deterred.

(3) *We should all become ecologists.* A critical insight for C-VNSA strategy is that webs of environments, interactions and processes both contribute to and constitute VNSA growth. Those involved in formulating anti-terror strategy need to be experts in these webs of structured interactive relationships. We could do worse than taking our cues from those who manage eco-systems such as foresters, farmers, and artificial life theorists. Or, as UCLA research fellow Raphael Sagarin maintains:

> The real challenge is to apply evolutionary thinking to homeland security in a more structured, broad-based manner. Evolutionary biologists, ecologists, and paleontologists

> understand better than anyone the evolutionary successes and failures of genes and species and what it takes to survive in the natural world. Officials prosecuting the war on terrorism should bring experts on evolution into the discussion.[22]

The members of the military profession involved in combating VNSA directly should, be part of a transformed cadre of military professionals, possessing a very different set of skills not traditionally associated with the warrior profession. This is not our grandfather's security environment. Biology, rather than physics, might be the operative structuring metaphor.

(4) *VNSA are not monolithic, nor do they exist in splendid isolation.* VNSA do not spring onto the international scene fully formed and made of solid granite. They develop over time, and as they do so, they articulate parts that have functions. VNSA are (thankfully) neither *hermetically* nor *hermeneutically* sealed. They exist as part of an open system and the parts of a VNSA are constantly exchanging matter and energy with that system; more, the meanings VNSA leadership use to reinforce group and role-specific identity, are not water-tight. Undermine a VNSA's "story," and you go a long way toward winning the hermeneutic struggle. VNSA are not granite-like rocks that can only be crushed. Instead, they are more like extremely porous stones—pour in the right kind of liquid at the right temperature, let it sit overnight, and the rock disintegrates from the inside, slowly falling apart.

(5) *Confrontation happens in many ways.* There are multiple paths towards successful confrontation with VNSA and the environments that generate them. We should not think of the war on terrorism as consisting only in armed struggle. Rather, aspects of this war may be more like the "war" on illiteracy—war-like in the sense that we take (or ought to take) the root causes of illiteracy very seriously and struggle mightily against them, but not war-like, in the sense that we shoot bullets at people who can't read. Effective use of the multiple instruments of state power is not to shrink from confrontation, nor to handle VNSA with kid gloves; rather, it is to boost our ability to successfully shape the international security environment in a maximally efficacious manner.

(6) *Effective, possibly non-traditional, intelligence is critical.* Doing this all well is an intelligence intensive enterprise. Much of our intelligence, especially military intelligence, is geared towards traditional battlefield-style warfare. The sources and methods used to gather this intelligence will be useful, but perhaps more useful will be improved *warning analysis* and *forecasting* related to the root causes and transformative processes discussed earlier in our work. Much of this intelligence will be open-source, but will be manpower intensive and require a rich conceptual infrastructure in order to organize effectively. Actionable intelligence needs to be placed in boxes that bear a clear connection to policy and strategy; open-systems theory does some of this work for us.

We don't mean to imply that none of these points are factored in to our current national security posture; on the contrary, seeds of them can be found scattered throughout our national security apparatus. Rather, our contention is that, in the main, we have *tended*, albeit not in every case, towards output confrontations, ignored deterrent options, undervalued ecological insights, treated VNSA monolithically and without due regard to their meaning-laden nature, defaulted to a narrow sense of confrontation rather than a broad sense, and not focused effectively on the appropriate intelligence tools. Moreover, our expertise is centered on specific groups, thus demanding a policy so nuanced that it lacks the cohesion required to synchronize the instruments of power. This is understandable, given the lack of a comprehensive framework for thinking about such organizations. If we are to overcome some of our disappointments with the results obtained thus far in our war on terror, we would do well to embrace systems thinking.

Research Agenda: Where to Now for VNSA?

In our work, we've visually scanned the visible portion of the VNSA iceberg, touching only its tip. Ninety percent of an iceberg, alas, lies underwater. Our brief survey, and attempt to formulate a synoptic theory of VNSA, unearths myriad research programs and questions that beg for further exploration if we are to truly understand this security challenge. Here are some of our suggestions regarding where, corporately, we ought to go next:

(1) *Use the open systems approach to structure our thinking about VNSA*. Currently, there exists no unifying paradigm that allows us to think and speak coherently about VNSA. While there are some advantages to having a piece-meal approach to a topic, there are considerable benefits to be gained by structuring conversations across a milieu using a common vocabulary. Our guess is that we can gain even deeper insight into many phenomena already well-discussed in the VNSA literature by rethinking some positions in light of open systems theory. The conceptual system we use to make sense of the world affects our ability to cope with it (compare the raw capacity of any five year old with that of any twenty year old), and the strength of open systems concepts as applied to terrorist groups lies in the explanatory unification and increased insight that results from using them. With insight comes the ability to *control* a system. Piece-meal approaches are useful, especially at the beginning of inquiry, but on the other hand nothing beats theoretical unification for increased prediction, control, and influence (and we'd like to do all these things for many VNSA).

(2) *Validate factual assumptions about the state of the super-system.* Have we appropriately identified the aspects of the international environment that are conducive to VNSA formation? Can we more precisely state the relationship between globalization and the rise of non-state actors? What other types of state failure contribute to VNSA genesis? Are there other interesting respects in which VNSA can construct environmental niches, or in which states can engage in niche destruction? These are all open questions. Our assumptions, while plausible and reflecting a broad consensus in the literature, nonetheless require further exploration to boost our confidence level and to gain insight into the web of ecological relations that is the international environment.

3) *Validate our initial take on super-system, system and sub-system relationships.* VNSA are very complex dynamic systems. While the general concepts we've used to discuss parts and relationships are sound, they require further investigation. Many relationships between system variables have not been explored in any detail (the general shapes of the curves that define those relationships are not even known in many cases, as we haven't thought to frame questions in this way). Moreover, our initial cut on functions may have overlooked other patterns of activity that contribute to a VNSA's prosperity. Ninety percent of the iceberg remains unexplored.

(4) *Boost rigor; drive quantitative analyses.* Some of our insights are driven by case-study based analyses. These are useful, but have their shortcomings. Ideally, some relationships which we discuss in qualitative terms could be expressed rigorously in a quantitative manner. This would allow us to more thoroughly "reverse engineer" terrorist organizations, working backwards from observed strategy and tactics to infer interior system structure and relationships. Possessing this capacity is important for the articulation of a good C-VNSA strategy.

(5) *Develop species-specific functional architectures.* VNSA are alike in the critical respects (in much the same way that people are alike in the critical respects, which is why it is possible to have a science of medicine); however, there are probably species-specific differences in functional architecture that space considerations have prevented us from exploring in any detail. For example, certain types of VNSA (e.g., religious movements) will leverage charismatic identity entrepreneurs for their continued influence more so than others (e.g., crime networks). This may result in crucial differences in the authority and maintenance sub-systems. Knowledge of these differences will be critical for driving C-VNSA strategy formulation.

(6) *Develop the allied intelligence tools and architecture required to validate the model and use it effectively.* To exhaustively validate some of the assertions made in our work will require a more theory-driven intelligence architecture than is in place at the national level currently. There is a fundamental shortage of methodologists in the intelligence community. We are not collecting against some of the variables and relationships necessary to gain full insight into the VNSA system. Our framework offers insight that will allow us to drive indications and warning decks, for instance; identifying VNSA signatures and growth profiles will cue us to potential areas of concern. The quality of our warning and threat estimates could increase if the thinking about them were structured in this way. Systems insights may drive more effective forecasting tools. Ideally, they could even allow us to answer Donald Rumsfeld's demand for a way to know whether we are winning the war on terror.[23] Developing the intelligence tools and architecture that makes the most sense for confronting VNSA given our framework is extremely important.

(7) *Put computational bite into the theory.* We've stressed the dynamic nature of the VNSA threat, and how our strategy should be sensitive to diachronic concerns. One way in which these arguments could be made more rigorous and useful is to translate them into workable computer models, like the ones we have presented, that allow analysts to accomplish forecasting, engage in stem and branch decision analysis, and stress test strategic options *in silico* before trying them on for size in real life. This is the task of the technical portion of our project, but a great deal of work remains if the theory is to be translated into workable computer models.

Much more remains to be done, as we've only scratched the surface in this text. Nonetheless, the work we've accomplished thus far has allowed us to address some of the issues that have plagued non-systematic approaches to VNSA; in this sense, open systems analysis of violent non-state groups is a *progressive* research program, capable of solving some of the anomalies that traditional approaches leave untouched.

Paradigm Shift: Resolving Anomalies, Securing Progress

The philosopher and sociologist of science Thomas Kuhn is famous for articulating the idea of a paradigm shift.[24] Kuhn postulated that all science is conducted with the boundaries of a paradigm: fundamental assumptions about what we should count as real and how we come to possess knowledge about those things. From paradigms fall such items as testing procedures, methodological considerations, and vocabularies. Eventually, paradigms may enter a crisis stage because of their inability to resolve anomalies. For instance, the Newtonian paradigm eventually entered crisis because of its inability to explain multiple stellar phenomena, including the precession of Mercury. When a new paradigm emerges that explains away the anomalies that the paradigm in crisis could not, is it oft-times adopted, becoming the new and normal way of doing science. Progress occurs by the successive replacement of failing paradigms with more expansive explanatorily fecund paradigms.[25]

Current approaches to VNSA understanding have multiple anomalies. Defense decision-makers have complained that we have no comprehensive understanding of terrorism as a phenomena; we have no way of knowing whether or not we are winning the war on it; ultimately, critics say, we are on unsure ground as we confront what could eventually become an existential challenge to our way of life. The way we best solve these anomalies, we contend, is by shifting to a more comprehensive framework that gives us the tools, methods, and vocabulary we need to be able to make sense of them. That new paradigm is the one we have articulated in the past eight chapters: the open systems framework can unify disparate approaches to VNSA, providing us comprehensive insight into how we can both effectively confront them across their entire life-cycle and measure whether or not our confrontation is effective.

There is much at stake here. The success of our national security posture rides on whether or not we are willing to think creatively and "outside of the box" about violent non-state actors. Nothing less is acceptable if we are to successfully confront a dynamic and growing threat to international security: warlords rising.

SUMMARY OF PROJECT

Understanding complex systems for the purpose of influencing or changing them is a difficult task for any analyst or policymaker. The tools we have applied to VNSA can be used to generate useful insights into multiple systems of interest, and will help us externalize and validate the mental models we use to think about the world. As evidenced by their use on operational issues, procedures from systems engineering can be applied to a variety of pressing problems, including that of understanding the growth of terrorist organizations. As the methodology matures, we believe that these tools can be tailored to inform effects-based planning for other complex systems and can usefully coevolve with the framework we are applying to understand violent non-state actors.

APPENDIX: SAMPLE PROJECT BRIEFING SLIDES DELIVERED IN MULTIPLE VENUES

COMBATING TERRORISM
A Framework for Strategy and for Modeling & Simulation

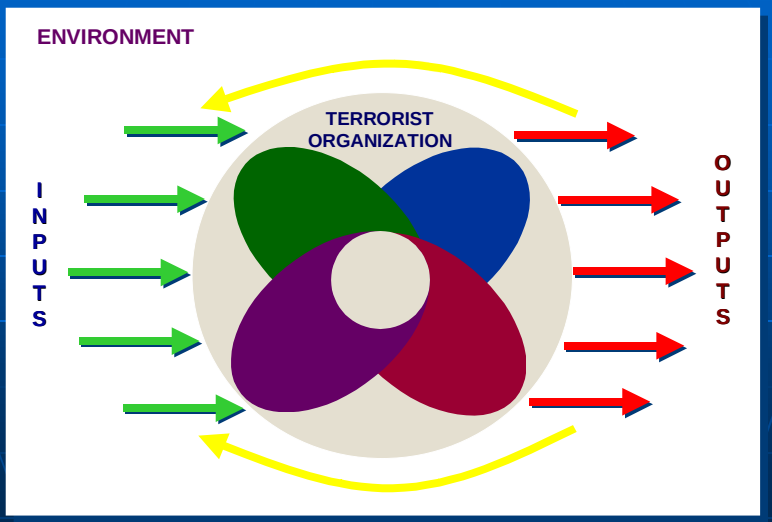
Captain Jake Bartolomei, USAF
Jason.bartolomei@usafa.af.mil
Major Bill Casebeer, USAF
william.casebeer@usafa.af.mil
Major Troy Thomas, USAF
troy.thomas@dia.mil

Briefing for Northern Command, 28 Apr 04

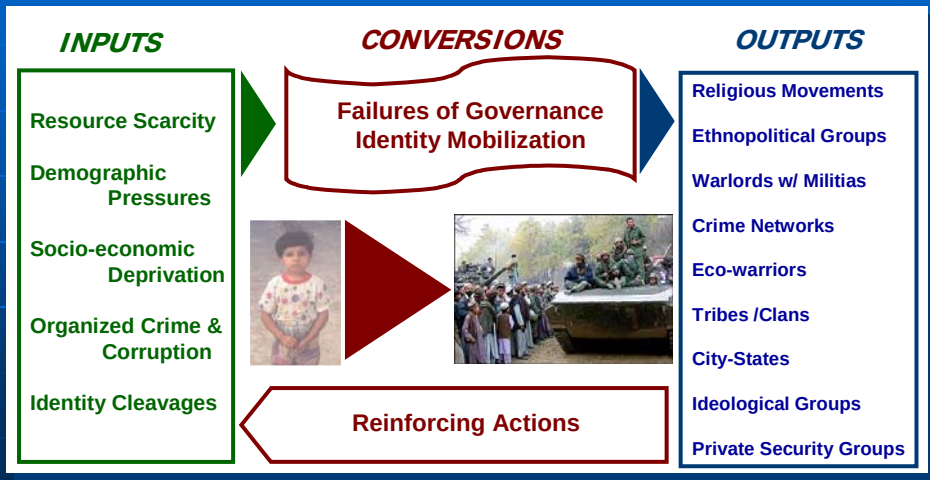
OBJECTIVES

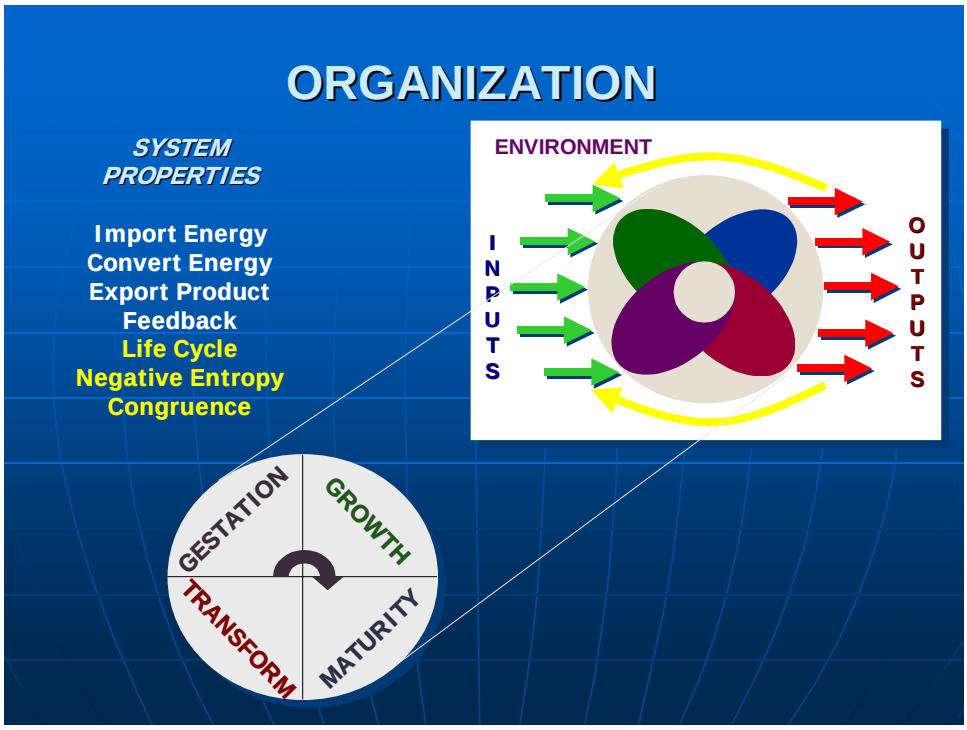
- EVALUATE ADVERSARY
- ACHIEVE EFFECTS
- ASSESS PROGRESS

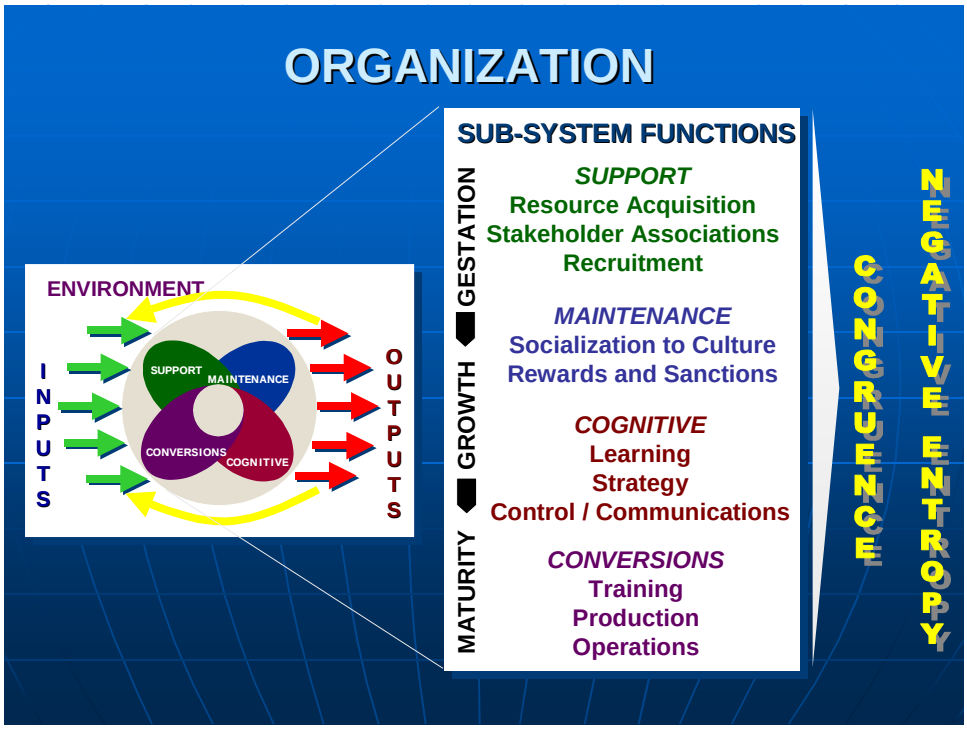
SYSTEMS ANALYSIS

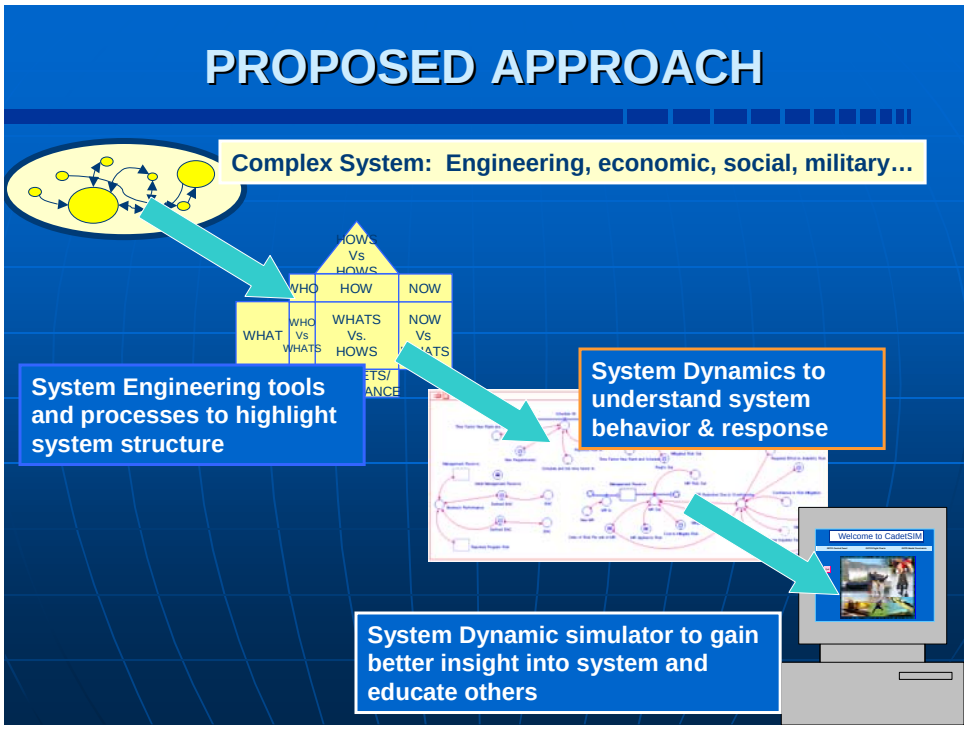


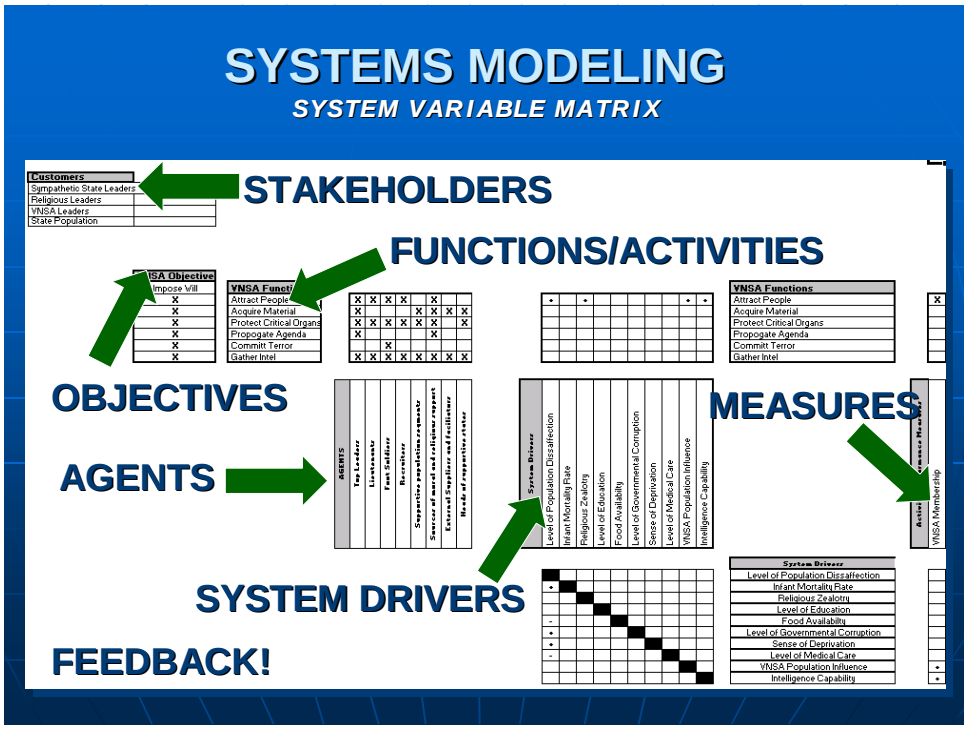
ENVIRONMENT




ORGANIZATION
SYSTEM PROPERTIES
Import Energy
Convert Energy
Export Product
Feedback
Life Cycle
Negative Entropy
Congruence
ENVIRONMENT
INPUTS
OUTPUTS
GESTATION
GROWTH
TRANSFORM
MATURITY

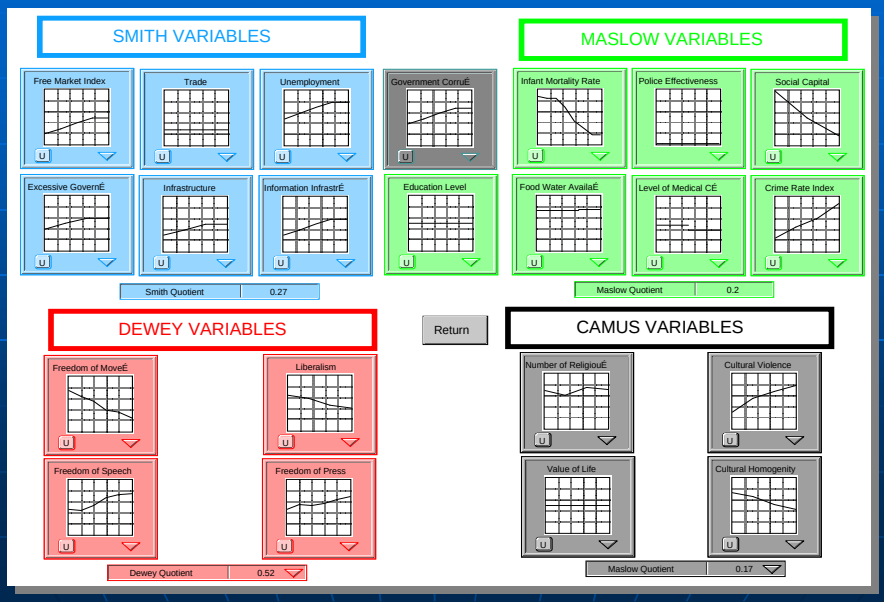

ORGANIZATION
ENVIRONMENT
INPUTS
OUTPUTS
SUPPORT
MAINTENANCE
CONVERSIONS
COGNITIVE
SUB-SYSTEM FUNCTIONS
GESTATION
GROWTH
MATURITY
SUPPORT
Resource Acquisition
Stakeholder Associations
Recruitment
MAINTENANCE
Socialization to Culture
Rewards and Sanctions
COGNITIVE
Learning
Strategy
Control / Communications
CONVERSIONS
Training
Production
Operations
CONGRUENCE
NEGATIVE ENTROPY


PROPOSED APPROACH
Complex System: Engineering, economic, social, military…
HOWS Vs HOWS
WHO
HOW
NOW
WHAT
WHO Vs WHATS
WHATS Vs. HOWS
NOW Vs WHATS
System Engineering tools and processes to highlight system structure
System Dynamics to understand system behavior & response
Welcome to CadetSIM
System Dynamic simulator to gain better insight into system and educate others

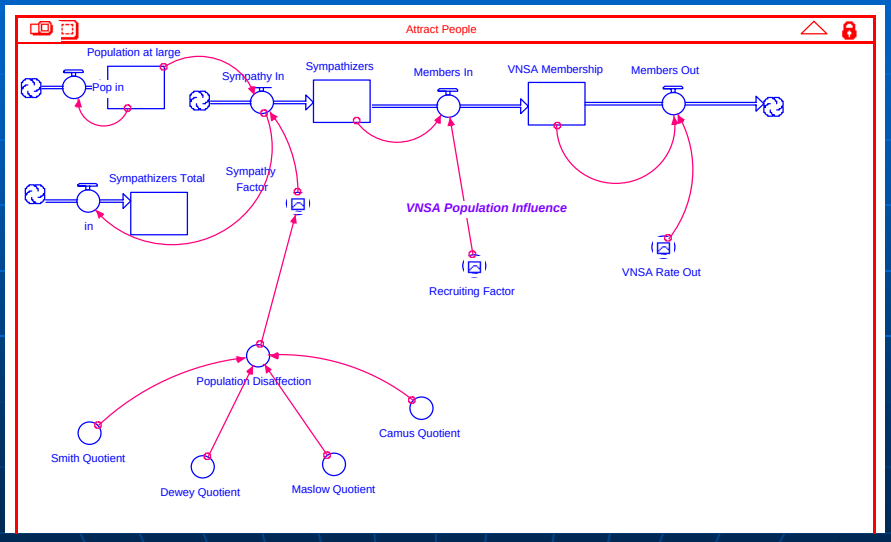

SYSTEMS MODELING
SYSTEM VARIABLE MATRIX
STAKEHOLDERS
FUNCTIONS/ACTIVITIES
OBJECTIVES
AGENTS
MEASURES
SYSTEM DRIVERS
FEEDBACK!

SYSTEMS MODELING

VARIABLE INTERFACE

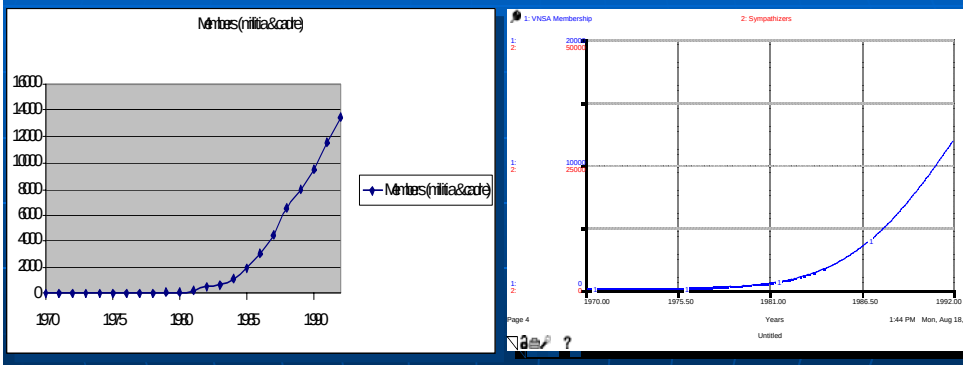


STRUCTURAL RELATIONS DERIVED FROM MATRIX



SYSTEMS MODELING

SENDERO LUMINOSO TEST CASE



Bonus: Model matched only data point for SL sympathizers (50,000 people)

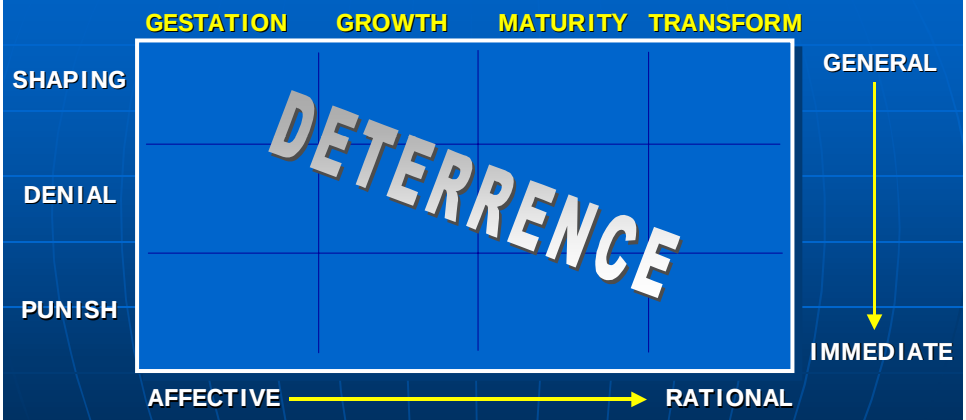
ADVANTAGES OF THE METHODOLOGY

- Efficient and cost effective process
  - Santa Fe Institute experience:
    - *Working* model…*significantly* less cost
- It offers a valid repeatable process for attacking Effects-Based Operations, Planning, and Analysis
  - Terrorism, Cadet Life, North Korea, Innovation
- It can usefully drive ISR requirements
- Friendly GUI = easy use for policy-makers
- Easily make on the fly changes to model
  - Assumptions can be manipulated by decision-maker

MODELING RESEARCH AGENDA

- Develop additional modules for all functions
- Test model against other data sets/VNSA
  - Pro-active in solicitation…mine our own data
- Improve feedback relationships
  - Encourage community to focus research
- Disseminate agenda/product to community

STRATEGY

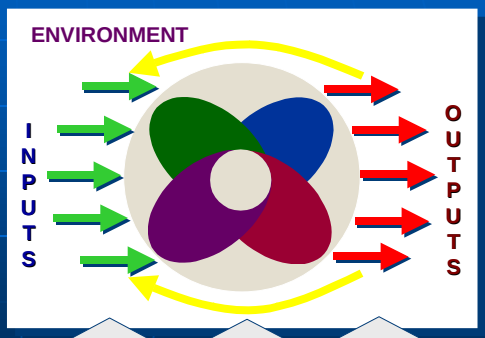


STRATEGY

DISRUPTION / DEFEAT

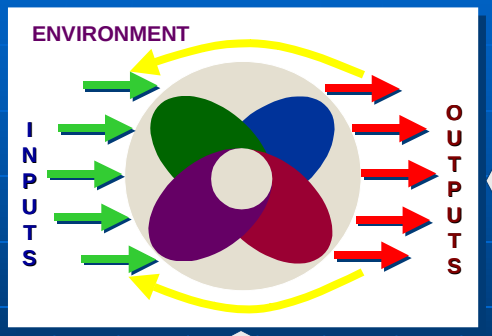
PRINCIPLES

Leverage life-cycles
Sever functions
Attack boundary layers
Attack well-connected nodes
Manipulate feedback loops
Leverage diachronic effects
Increase uncertainty
Generate positive entropy
Disrupt congruence



IMPLEMENT ACROSS SYSTEM

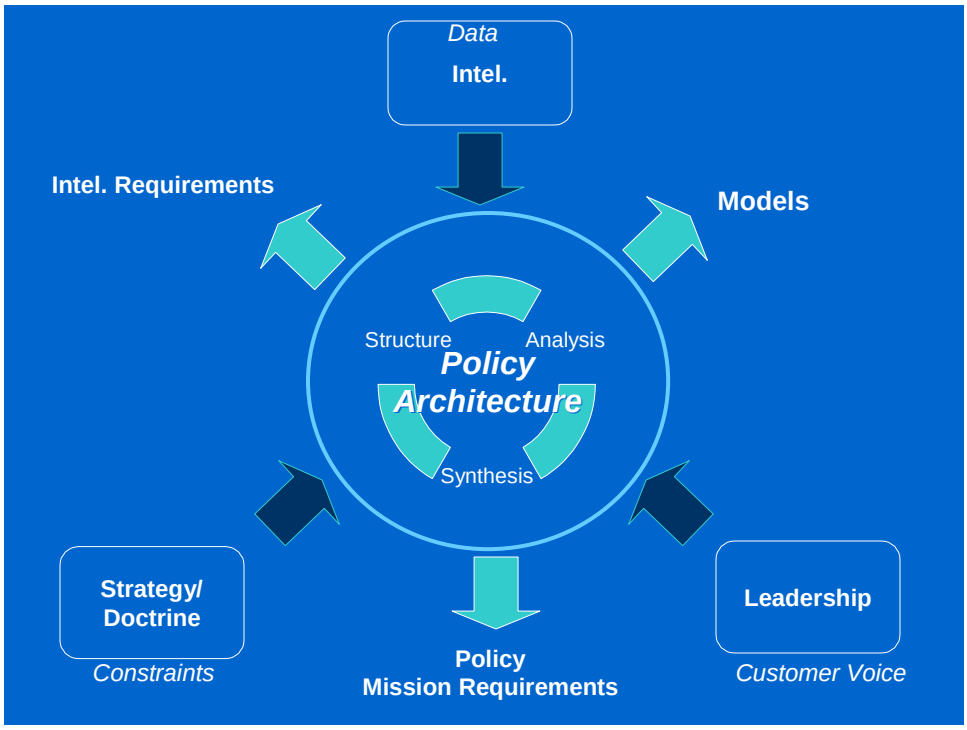
ASSESSMENT



RESOURCE UTILIZATION

GOAL ATTAINMENT

PROCESS EFFICIENCY



CONCLUSION

- **Strategy Process**
  - Scan environment to forecast / identify adversaries
  - Evaluate w/ levels of analysis
  - Deter w/ affective and rational tactics
  - Employ principles to disrupt and defeat
  - Assess progress across system
- **Road Ahead**
  - Apply concepts to military strategy
  - Apply methods to specific terrorist groups
  - Tailor products to customer…how can we help decision-makers like you?

COMBATING TERRORISM
A Framework for Strategy and for Modeling & Simulation

Captain Jake Bartolomei, USAF
Jason.bartolomei@usafa.af.mil
Major Bill Casebeer, USAF
william.casebeer@usafa.af.mil
Major Troy Thomas, USAF
troy.thomas@usmc.mil

Briefing for Northern Command, 28 Apr 04

Endnotes

[1] For a primer on diagnosis, refer to Michael I. Harrison, *Diagnosing Organizations: Methods, Models, and Processes* (Thousand Oaks, CA: SAGE Publications, Inc., 1994).
[2] Ibid., 10.
[3] Ibid., 39.
[4] Thomas G. Cummings, quoting von Bertalanffy in *Systems Theory for Organization Development* (New York, NY: John Wiley and Sons, 1980), 6.
[5] Richard L. Daft, *Organization Theory and Design* (Mason, OH: Thomson South-western, 2004), 14.
[6] Daniel Katz and Robert l. Kahn, "Organizations and the System Concept," *The Social Psychology of Organizations* (New York, NY: John Wiley and Sons, 1966). Reprinted in *Classics of Organization Theory*, Jay M. Shafritz and J. Steven Ott, eds. (Fort Worth, TX: Harcourt College Publishers, 2001), 259.
[7] Ibid., 14.
[8] Michael I. Harrison and Arie Shirom, *Organizational Diagnosis and Assessment: Bridging Theory and Practice* (Thousand Oaks, CA: Sage Publications, 1999), 44.
[9] Katz and Kahn, *Classics*, 262.
[10] Daft, *Organization*, 15.
[11] Harrison and Shirom, *Organizational*, 47-48.
[12] Ibid., 42.
[13] Ibid., 43.
[14] The phrase, "face of battle," is a reference to our work of the same title by John Keegan, which confronts and illuminates the harsh reality of war on individual soldiers and units. *Face of Battle* (New York, NY: Penguin Books, 1976.
[15] Refer, for example, Chapter 15 of Gustavo Gorriti's, *The Shining Path: A History of the Millenarian War in Peru* (Chapel Hill, NC: University of North Carolina Press, 1999). Guzman's plans for replacing the government of Peru with a Maoist regime are made explicit in great detail.
[16] Paul Davis and Brian Jenkins, *Deterrence and Influence in Counterterrorism: A Component in the War on al Qaeda* (Santa Monica, CA: RAND Corporation, 2002), 15.
[17] See David Scott Palmer, "The Revolutionary Terrorism of Peru's Shining Path," printed in *Terrorism in Context*, ed. Martha Crenshaw (University Park, PA: The Pennsylvania State University Press, 1995). Palmer is careful to place large error bars on the estimates we use in the text.
[18] Including analysts at the RAND Institute (both Santa Monica and Virginia headquarters) and terrorism experts at various academic conferences.
[19] Jackknifing can be used both to combat over-fitting and to build and test models where data is difficult to obtain or where multiple controlled experiments cannot be conducted. The data-set is split in half. Half the data set is then used to build the model, while the other half is used to test the model.
[20] See, for example, the forthcoming book Warlords Rising: Confronting Violent Non-State Actors by Troy S. Thomas, Stephen D. Kiser, and William D. Casebeer. See also two Institute for National Security Studies Occasional Papers (http://www.usafa.af.mil/inss/OCP/OCP52.pdf and http://www.usafa.af.mil/inss/OCP/OCP43.pdf), as well as two "Strategic Insights" published by the Center for Contemporary Conflict at http://www.ccc.nps.navy.mil/si/2004/mar/casebeerMar04.asp and http://www.ccc.nps.navy.mil/rsepResources/si/dec02/terrorism2.asp.
[21] See the original article in *USA Today* of 22 October 2003 available at http://www.usatoday.com/news/washington/executive/rumsfeld-memo.htm as of 10 January 2004, or the excellent summary of the incident from *Slate Online Magazine* at http://slate.msn.com/id/2090250/ available as of 10 January 2004.

[22] See his “Adapt or Die: What Charles Darwin can teach Tom Ridge about homeland security,” *Foreign Policy* (September/October 2003): 68-9.

[23] Ibid. Rumsfeld asks: "Today, we lack metrics to know if we are winning or losing the global war on terror. Are we capturing, killing or deterring and dissuading more terrorists every day than the madrasses and the radical clerics are recruiting, training and deploying against us?"

[24] Thomas Kuhn, *The Structure of Scientific Revolutions* (Chicago, IL: The University of Chicago Press, 1962).

[25] For technical reasons regarding the incommensurability of vocabularies between paradigms, Kuhn is sometimes cast as a skeptic regarding the idea of scientific progress. We can set aside this concern for present purposes. Even if paradigms *are* problem-driven, and our problems *change* from epoch to epoch, it still remains the case that solving the VNSA problem is critical currently.

ABOUT THE INSTITUTE

The Institute for Information Technology Applications (IITA) was formed in 1998 to provide a means to research and investigate new applications of information technology. The Institute encourages research in education and applications of the technology to Air Force problems that have a policy, management, or military importance. Research grants enhance professional development of researchers by providing opportunities to work on actual problems and to develop a professional network.

Sponsorship for the Institute is provided by the Assistant Secretary of the Air Force (Acquisition), the Air Force Office of Scientific Research, and the Dean of Faculty at the U.S. Air Force Academy. IITA coordinates a multidisciplinary approach to research that incorporates a wide variety of skills with cost-effective methods to achieve significant results. Proposals from the military and academic communities may be submitted at any time since awards are made on a rolling basis. Researchers have access to a highly flexible laboratory with broad bandwidth and diverse computing platforms.

To explore multifaceted topics, the Institute hosts single-theme conferences to encourage debate and discussion on issues facing the academic and military components of the nation. More narrowly focused workshops encourage policy discussion and potential solutions. IITA distributes conference proceedings and other publications nation-wide to those interested or affected by the subject matter.